THE PRINCIPLES OF CHECK FIGURE SYSTEMS

BY

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THE PRINCIPLES

OF

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FOR

ACCOUNTANTS AND BOOKKEEPERS.

With numerous devices for quickly obtaining the check-figure of Pounds, Shillings and Pence, or Decimal Coinage from 5 selected base-numbers; and special hints for discovering Errors.

BY

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TO

THOMAS W. TWYFORD, Esq., J.P., D.L.,

OF

Whitmore Hall, Staffordshire,

In grateful acknowledgment of the experience gained from numerous investigations, necessitating quick methods, entrusted to me during the past fourteen years in England, and more recently in Germany.

PREFACE.

SEVERAL secret Check Figure Systems are in use in this country, for which fees varying from two to five guineas have originally been charged.

The Author is personally aware that some of those Systems are either not sufficiently quick or reliable to merit their adoption by Bookkeepers generally, and endeavours in the following treatise to overcome, as far as possible, the obstacles which deter many commercial houses from adopting a System which is certain to lessen the anxiety of a Bookkeeper at the periodical balancing of his books.

No great progress in this direction may be expected if such a system is not fully disclosed until a high fee is paid; and while the Author expresses his indebtedness to those Accountants who have related their experiences, and defined the limitations of certain systems, he is of opinion that much which has hitherto been written on the subject has been in ignorance of the quicker methods only divulged to those who pay the current secret system rates.

A Check Figure System is a strain upon any Bookkeeper unless the check-figure can be obtained *almost by inspection*, and it is unprofitable to adopt any base-number which will not detect over 500 possible mispostings through transpositions of Pounds, Shillings and Pence.

The Author is thoroughly convinced that some Check Figure Systems now in use would never

have obtained favour if the facts demonstrated in these pages had been clearly set forth. Possibly the inventor has not been cognisant of the weaknesses of his own particular System, and it is hoped that a perusal of these pages will convince the purchasers of such Systems that a further endeavour was essential in order to obtain a Check Figure System which would reduce the number of possible mispostings to a minimum, and at the same time lessen, if possible, the mental calculation necessary for extracting the check-figure. The formulæ for the various base-numbers are the results of independent calculations made by the Author in order to obtain the quickest possible method of arriving at the check-figure, and while they may differ from those suggested by other Authors, the errors shown under each base-number will not be detected by using any other formula, provided no device has been introduced, in the manner indicated herein, to alter the relative values of one pound, one shilling and one penny.

After a careful study of the Systems based on the numbers 7, 14, 13 and 17, selected as most suitable for catching transpositions in the Pounds column, and speedily ascertaining the check-figure, the Author submits that the System recommended by him in these pages is not only quicker but more reliable than those Systems.

The Author is indebted to his friend Mr. H. Davis, of Leek, for assisting him in revising the proofs.

Spencer Avenue,
Leek.

April, 1908.

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OF

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THE five base-numbers selected are as follow:—

1st	...	...	7
2nd	...	...	14
3rd	...	...	13
4th	...	...	17
5th	...	...	19

The base-number 7 has been included in the selection solely to assist the reader in grasping the principles of the Check Figure System, as he has been thoroughly conversant with the 7 mul-

tiplication table from infancy. The multiples of the other base-numbers must first be learned before the system can be fully appreciated.

The composite number 14 has been introduced with the view of ascertaining the actual effects produced by adopting any multiple of one of the prime numbers as a base-number.

To have omitted the base-number 7, as other writers have evidently done, chiefly on account of the same check-figures constantly recurring and thereby rendering the system of little use, would have considerably diminished the interest which the reader will doubtless manifest at once in the following statement:—

The check-figure of millions of Pounds can be speedily determined.

It is only necessary at this stage to explain that the check-figure is ascertained by throwing out all multiples of a certain number chosen by the bookkeeper as best adapted for his purposes and retaining only the remainder, which is called the check-figure.

Required the check-figure of £163,204,342.

The process with base-number 7 is as follows:—

Tick off each set of three figures beginning from the right.

From 204 take 163 leaves 41.
„ 342 „ 41 „ 301.

The check-figure of £163,204,342 is equivalent to the check-figure of £301.

To obtain the check-figure of £301

Multiply the hundreds by 2

and

Add the product to the last two figures considered as so many units, *e.g.*

$$3 \times 2 = 6$$
$$6 + 1 = 7$$

The check-figure of 7 is 0

as 7 divided by 7 is 1 and leaves no remainder.

Another method:—

Ascertain the check-figure of each set thus:—

	£163	204	342
Check-figure	2	1	6

Add the 1st and 3rd check-figures

and

Deduct the 2nd check-figure,

e.g. $2 + 6 - 1 = 7$ *i.e.* 0.

The check-figure of £163,204,342 is 0.

It is obvious that to obtain the check-figure in the usual manner is to render the whole system in respect of large amounts entirely useless *e.g.*

$$7)\underline{163,204,342}$$
$$\underline{23,314,906} = 0$$

For our purpose 23,314,906 is unnecessary: we

only want to know the remainder after throwing out the multiples of 7.

If a laborious calculation can be done by this simple process, surely smaller amounts which appear more regularly in our books can all the more easily be dealt with. Even in the United States and in Continental towns, this large figure would seldom have to be treated in books. In the United States, for example, it would represent

1,632,043 dollars 42 cents.

On what principle is this check-figure so easily obtained?

Principle of ascertaining Check-figure of £ column explained.

The multiples of 7 in the case of tens and units can be easily thrown out.

$100 \div 7 = 14\frac{2}{7}$

∴ 2 is the check-figure of 100

$1{,}000 \div 7 = 142\frac{6}{7}$

∴ 6 is the check-figure of 1,000

$10{,}000 \div 7 = 1428\frac{4}{7}$

∴ 4 is the check-figure of 10,000

$100{,}000 \div 7 = 14285\frac{5}{7}$

∴ 5 is the check-figure of 100,000

$1{,}000{,}000 \div 7 = 142{,}857\frac{1}{7}$

∴ 1 is the check-figure of a million.

If we ascertain the check-figure of £1 which

is 1 (as explained in the section devoted to the base-number 7)

then the check of £2 will be 2
£3 „ 3
£10 „ 10 or 3
(throwing out the 7)

Similarly, if we reckon in hundreds

The check of	£100	being	2
„	£200	will be	4
„	£300	„	6
„	£400	„	8 or 1
„	£500	„	3
„	£600	„	5
„	£700	„	0
„	£800	„	2
„	£900	„	4
„	£1000	„	6

The check for £1000 agrees with the check-figure obtained by the process of elimination shown above.

A positive check of 6 in a system the base-number of which is 7

is equivalent to

A negative check of 1 *(i.e. minus 1)* and by the conversion of this positive check of 6 into a negative check of 1, the process of casting out the multiples of 7 is considerably lessened.

As the vast majority of commercial books in this country show under one million pounds of a

total turnover it is useless dealing with more than five or six figures, except to interest the reader *at the outset* to such an extent that he will patiently study the following pages and discover more intricate processes which have been used in attempting to solve a problem which may be beneficial to the accountancy profession.

Take for example £57,312.

If the check for £1,000 is −1
the check for £57,000 will be −57 or −1
(throwing out 56 the multiple of 7)

57 from $312 = 255 \div 7 = 36\frac{3}{7}$
or 1 from $312 = 311 \div 7 = 44\frac{3}{7}$

The check for £57,312 is therefore 3.

A SIMPLER METHOD.

(A) Ascertain the check of 57
(B) „ „ „ 312

The check of 57 is, *by inspection*, 1

The check of 312 is obtained thus:—

$3 \times 2 = 6 + 12 = 18 \div 7 = 2\frac{4}{7}$

∴ the check of 312 is 4.

(A) The check obtained is a negative check (as $1 \times -1 = -1$)

(B) The check obtained is a positive check (as the check-figure for each unit is +1)

The check required in this case is positive
∴ the check of £57,312 is $4 - 1 = 3$

To the reader unaccustomed to a Check Figure System it will probably seem impossible that multiples of some of the other selected base-numbers can be cast out from a number having three figures more quickly than the above process. This fact will be demonstrated later.

The treatment of positive and negative checks will be better understood after studying the variation in the check-figure for each unit, hundred and thousand.

Transposition of Figures in Pounds Column considered.

Place the check for each unit, ten, hundred, etc., as ascertained on page 4 in position over any large number of pounds, *e.g.*

546,231
A £563,241

Copy these figures erroneously *e.g.*

B £562,341

It will be obvious to the expert accountant that the check-figure of £562,341 cannot be the same as the check of £563,241 as the figures £56..41 *in position* will give the same check-figure and the check of the £3,200 posted (or carried forward in a Sales Journal to the next page) as £2,300 will affect the final check-figure as follows:—

(A) $3 \times 6 = 18$
$2 \times 2 = 4$

22 or 1

(B) $2 \times 6 = 12$
$3 \times 2 = 6$

18 or 4

Consequently the check of B will be three more than the check of A.

Consider the 7 basis alongside the results obtained by adopting the same principle respecting the other base-numbers.

Base-number 14

12 4 6 2 10 1
£ 5 6 3 , 2 4 1

Base-number 13

4 3 *12 †9 10 1 * or — 1 † or — 4
£ 5 6 3 , 2 4 1

Base-number 17

6 4 *14 †15 10 1 * or — 3 † or — 2
£ 5 6 3 , 2 4 1

Base-number 19

3 6 *12 5 10 1 * or — 7
£ 5 6 3 , 2 4 1

Base-number 7

5 4 *6 2 3 1 * or — 1
£ 5 6 3 , 2 4 1

The check-figure placed above each unit, ten, hundred, etc. is a positive check, and as it

simplifies calculations in the case of the base-number 17 to convert the positive check for each hundred, *i.e.* 15, into a negative check, *i.e.* -2, the reader should test a few figures in the following manner in order to appreciate to the full extent the quicker methods suggested herein for dealing with large amounts, *e.g.*

$$241 \div 17 = 14\tfrac{3}{17}$$

$\therefore$ 3 is the check-figure of 241.

Treating the figures separately the same check-figure is arrived at thus:—

	$200 = 2 \times$	$-2 =$	-4
	$40 = 4 \times$	$10 =$	$+40$
	$1 = 1 \times$	$1 =$	$+1$
Total	241		37

$$37 \div 17 = 2\tfrac{3}{17}$$

The tens and units, however, should be reckoned as 41 units, *e.g.*

$$41 \times 1 = 41$$

Similarly, it may be advisable to treat the figures preceding the tens as so many tens, more especially when the check-figure for each ten may readily be converted into the unit scale as will be shown later in the examples for casting out the multiples of 19.

It will be noticed:—

That the base-numbers 7 and 13 facilitate

the calculation of the check-figure by deducting the first three figures or thousands from the last three figures and thus speedily arriving at the check-figure.

That the check of the hundreds is very quickly obtained by every base-number; if anything, more quickly by the 7 and 14 bases.

That it is, *prima facie*, very unlikely that, with *any* of these base-numbers, a transposition of the figures would not be detected by a different check-figure from the original.

As the adoption of the base-number 7 (if practicable) would make the Check Figure System as explained herein a pleasant rather than an irksome task for the average bookkeeper, even for amounts made up of pounds, shillings, pence and farthings, it has been deemed advisable to show under what circumstances such a system, which enables the check-figure to be put down *almost by inspection* and which considerably reduces the extra work entailed when posting up a Ledger, may be rendered useless.

Are Check Figure Systems reliable?

Mr. Thomas John Millar, M.A., LL.B., C.A., in his admirable handbook entitled "Check Numbers and other Aids to Balancing Books of Account,"

published by Messrs. George Waterston and Sons, of Edinburgh, clearly proves that there is no perfect base-number or "modulus," and that modulus 17, recommended by him as the most appropriate for detecting errors, will not catch at least 89 mispostings as compared with 120 similar mistakes for amounts under £100 by using the modulus 13.

Some of those errors would hardly be made by competent bookkeepers, and it would be considered a sufficient recommendation for the adoption of any Check Figure System if it enabled the following classes of error to be detected, viz:—

Class.										*Difference*		
	£	s.	d.			£	s.	d.		£	s.	d.
(1)	0	2	3	posted as		0	3	2		0	0	11
(2)	1	2	3	„	„ (a)	1	3	2		0	0	11
				„	„ (b)	2	3	1		1	0	10
				„	„ (c)	2	1	3		0	19	0
				„	„ (d)	3	1	2		1	18	11
				„	„ (e)	3	2	1		1	19	10
(3)	0	2	3	„	„	2	3	0		2	0	9
(4)	0	0	1	„	„	1	0	0		0	19	11

(5) Posting £123 as £132, £231, £213, £312, or £321.

(6) Posting the last figure in the pounds or shillings column in the next column.

or

Posting the first figure in the shillings

or pence column in the preceding column.

(7) Posting a debit as a credit and *vice versa*.
(8) Omitting to bring down a balance.
(9) Bringing down a debit balance as a credit balance and *vice versa*.

Classes 7, 8 and 9 will be dealt with when explaining the practical part of the System under base-number 7.

Other errors will be dealt with in Part IV.

Errors under Class 1.

All errors under Class 1 will be multiples of 11, and as 11 is the highest number in the pence column, and 0 the lowest number, the greatest error will not exceed 121 pence *e.g.*

0/11 posted as 11/0

would mean a difference of 10/1 or 121 pence.

Consider the multiples of 11 in relation to the particular base-number adopted:—

$1 \times 11 = 11$
$2 \times 11 = 22$
$3 \times 11 = 33$
$4 \times 11 = 44$
$5 \times 11 = 55$
$6 \times 11 = 66$
$7 \times 11 = 77$
$8 \times 11 = 88$
$9 \times 11 = 99$

$10 \times 11 = 110$

$11 \times 11 = 121$

Dividing each multiple by 7, 14, 13, 17 and 19 it is at once apparent:—

(1) That any difference caused by the transposition of shillings and pence, amounting to 77 pence, will not be detected by the base-number 7 as the wrong amount will have the same check-figure as the right amount, 77 being a multiple of 7.

(2) That the other base-numbers will detect any transposition of shillings and pence, as no multiple of 11 up to 121 is exactly divisible by any of them.

Errors under Classes 2, 3 and 4.

The differences shown under Class 2 are either multiples of 11 or 19, or of both numbers combined.

	£	s.	d.	
(a)	0	0	11	is a multiple of 11.
(b)	1	0	10	is made up of 19/- and a multiple of 11.
(c)	0	19	0	is a multiple of 19.
(d)	1	18	11	is made up of a multiple of 19 *i.e.* ... ... 38s. 0d. and a multiple of 11 0s. 11d.
				38s. 11d.

(e) £1 19 10 is made up of a multiple of
19 *i.e.* ... ... 38s. 0d.
and a multiple of 11 1s. 10d.

39s. 10d.

The differences shown under Classes 3 and 4 may be placed in the same category as Class 2.

The ideal system is therefore only to be obtained by adopting 19 as the base-number, provided the class of error denoted under 2 (c) can be eliminated. This process of elimination of error is explained on page 21.

It has already been shown that the base-numbers 14, 13, 17 and 19 will detect transpositions of shillings and pence such differences not exceeding 10/1 or 121 pence.

The greatest number of pence is 11 and if this is posted as £11 the difference will be £10 19s. 1d. which is made up of

	£	s.	d.		
11d. × 11 =	0	10	1 =	121	pence.
19/- × 11 =	10	9	0 =	2508	„
			Total	2629	pence.

If the total, 2629, is divided by 19 the remainder or check-figure is 7 which is also the check-figure of 121 pence, 2508 being a multiple of 19.

The greatest number appearing in the shillings

column being 19 and the lowest being 0 the greatest difference will be

19/- posted as £19 0s. 0d.

i.e. a difference of 18 1s. 0d. or 361/-

Write down the multiples of 19 up to 361.

1	19	8	152	14	266
2	38	9	171	15	285
3	57	10	190	16	304
4	76	11	209	17	323
5	95	12	228	18	342
6	114	13	247	19	361
7	133				

Dividing each of these multiples by each of the base-numbers 7, 14, 13 and 17, the check-figure is as follows:—

Base-numbers			7	14	13	17
The check-figure for	19	is	5	5	6	2
,,	38	,,	3	10	12	4
,,	57	,,	1	1	5	6
,,	76	,,	6	6	11	8
,,	95	,,	4	11	4	10
,,	114	,,	2	2	10	12
,,	133	,,	0	7	3	14
,,	152	,,	5	12	9	16
,,	171	,,	3	3	2	1
,,	190	,,	1	8	8	3
,,	209	,,	6	13	1	5
,,	228	,,	4	4	7	7

Base-numbers		7	14	13	17
The check-figure for	247 is	2	9	0	9
„	266 „	0	0	6	11
„	285 „	5	5	12	13
„	304 „	3	10	5	15
„	323 „	1	1	11	0
„	342 „	6	6	4	2
„	361 „	4	11	10	4

Observe :—

That the transposition of pounds and shillings will not be detected :—

With base-number 7.

When the differences are also multiples of 7 and 14.

With base-numbers 14, 13 and 17.

When the differences are also multiples of 14, 13 and 17 respectively.

That, when the differences represent a combination of multiples of 19 and 11, and the check-figures of the multiples added together equal the base-number or a multiple of the base-number, transpositions showing such differences will not be detected.

It will therefore require serious consideration, on the part of the bookkeeper, whether the base-number hitherto adopted by him, or that now chosen to suit his own personal needs, is suf-

ficiently accurate; and to enable him to arrive at a proper conclusion, *the most probable errors*, viz., transpositions of shillings and pence as pounds and shillings and *vice versa* are shown in Part IV.

As regards base-numbers 14, 13, 17 and 19 it has been proved that the classes of error denoted under 1 and 2a, on page 11, will be detected by a different check-figure appearing in each case, but

as regards base-number 7

it has been shown that any transposition of shillings and pence creating a difference of 77 pence or 6/5 will not be detected.

The amounts capable of such transposition are as follow:—

0/7	posted as	7/0	and *vice versa.*
1/8	,,	8/1	,,
2/9	,,	9/2	,,
3/10	,,	10/3	,,
4/11	,,	11/4	,,

Observe:—

That in each case the difference between the shillings and pence is 7 and that this difference multiplied by 11 is 77. The importance of this note will be appreciated very shortly by the reader.

Take *any* three figures and place them in the £ s. d. columns, *e.g.*

£4 3s. 9d.

Transpose £4 3s. 9d. in the same order as shown under Class 2 on page 11 thus:—

	£	s.	d.		£	s.	d.
(a)	4	9	3	difference	0	5	6
(b)	3	9	4	„	0	14	5
(c)	3	4	9	„	0	19	0
(d)	9	4	3	„	5	0	6
(e)	9	3	4	„	4	19	7

Observe the same order of transposition and accustom yourself to classify the particular difference involved by such transposition as follows:—

SCHEDULE A.

Transposition of Shillings and Pence only.

Difference always a multiple of 11 and the multiple is obtained from the difference between the number of shillings and the number of pence.

SCHEDULE B.

Transposition of Pounds, Shillings and Pence.

Pounds as pence.
Shillings as pounds.
Pence as shillings.

Difference is made up of

	£	s.	d.
A multiple of 19/-, viz....	0	19	0
minus			
A multiple of 11d., viz....	0	4	7
	0	14	5

The multiple of 19/- represents the Difference between the pounds and shillings.
The multiple of 11d. represents the Difference between the pounds and pence.

SCHEDULE C.

Transposition of Pounds and Shillings only.

Difference always a multiple of 19/- and the multiple represents the Difference between the pounds and shillings.

SCHEDULE D.

Transposition of Pounds, Shillings and Pence.

Pounds as shillings.
Shillings as pence.
Pence as pounds.

Difference is made up of

	£	s.	d.
A multiple of 19/-, viz. ...	4	15	0
and			
The same multiple of 11d. as in Schedule A, viz: ...	0	5	6
	5	0	6

The multiple of 19/- represents the Difference between pounds and pence.
The multiple of 11d. represents the Difference between shillings and pence.

SCHEDULE E.

Transposition of Pounds and Pence only.

Difference is made up of

	£	s.	d.
The same multiple of 19/- as in Schedule D, viz: ...	4	15	0
and			
The same multiple of 11d. as in Schedule B, viz: ...	0	4	7
	4	19	7

The multiple of 19/- represents the Difference between pounds and pence,
and
The multiple of 11d, represents the Difference between pounds and pence.

The errors which may be classified under Schedules A, B, C, D, and E, and which will not be detected by adopting any of the base-numbers 7, 14, 13, and 17 are fully dealt with in Part IV.

The errors which will not be detected by adopting base-number 19 must be enumerated under Schedule C unless some device is suggested for eliminating errors caused by the transposition of pounds and shillings.

Base-number 19.

The check-figures for pounds, shillings and pence as shown in Part III were originally obtained by reducing 1 pound, 1 shilling, and 1 penny, to the common denominator of an eighth of a penny

in order to facilitate the calculation of the pounds column and were as follow:—

For each £1	...	1
„ 1/-	...	1
„ 1d.	...	8

and as 8 is equivalent to a negative check of 11 which saves multiplication these may be converted as follow:—

For each £1	...	1
„ 1/-	...	1
„ 1d.	...	−11

Suggestions for eliminating errors under Schedule C.

(1) If double instead of single columns are provided for the check-figure in all subsequent account books ordered by the bookkeeper, the first column to be used when the pounds exceed the shillings, and the second column to be used when the shillings exceed the pounds, all errors under Schedule C may be detected.

(2) Is it possible, in order to avoid double columns, to alter the check-figure for one shilling so that the check-figures for the same number of pounds and shillings will always vary, and at the same time detect errors which may be classified under Schedules A, B, D, and E?

The problem is most interesting, as a different check-figure for shillings may be found serviceable

for reducing the mental calculations necessary to obtain the check-figure; and *as the 19 base-number is the one strongly recommended by the Author to be used by every bookkeeper*, the effect of the latter device may be advantageously considered.

It is a common practice to note in pencil the number of pence and the number of shillings carried forward to the next column when adding the pence and shillings columns respectively. There seems, therefore, no difficulty in adopting a check-figure for one shilling which will either negative the check-figure for one pound or one penny, and thus reduce the calculation.

The original formula, as shown on page 21, may be amended as follows:—

For each	£1	...	1
„	1/-	...	11
„	1d.	...	−11

The addition of 10 to the check-figure for each shilling makes the calculation necessary at each addition of the Primary Records or Ledger Accounts very simple.

Assume that the addition of any page in a Sales Journal shows that 3 has been carried forward from the pence column and 20 from the shillings column and that 6 shillings appear in the total, then the number of shillings affected by the addition of 10 to the check-figure for each shilling is

£20 × 20 = 400/- + 6/- −3/- = 403/-

Ascertaining the check-figure of the total as it stands in the Sales Journal by using the *original* formula, viz:—

Multiplying pounds and shillings by 1
„ pence by −11

it will be obvious that the check-figure of the total cannot agree with the total of the check-figures as ascertained by the amended process to the extent of the check-figure of 4030/- If the difference is exactly the check-figure of 4030/- the details will have been posted as accurately as the system can determine. The check-figure carried forward to the next page should be the check-figure as ascertained by the amended process.

A SIMPLER PROCESS

is to add 17 or −2 to the check-figure of each shilling so that the amended formula reads:—

Check for	£1	... 1
„	1/-	... −1
„	1d.	... −11

In this case a negative check is easier to calculate. The difference between the pounds and shillings should first be ascertained, and if the shillings exceed the pounds the difference being negative should be added to the pence multiplied by 11; if the pounds exceed the shillings the difference should be deducted from the pence multiplied by 11.

Where the pounds are generally greater than the shillings, it will be preferable to use the positive check for debits and the negative check for credits. This treatment of positive and negative checks for debits and credits respectively is fully explained in Part II.

As the adoption of either of the formulæ for the base-number 19 will have the effect of reducing the number of errors as compared with the results obtained by adopting any other base-number less than 19, and as it is not improbable that the first suggestion for overcoming the difficulty of obtaining an almost perfect Check Figure System, viz., the adoption of double columns, may not meet with general favour on account of the tendency to enter the check-figure in the wrong column, the formula strongly recommended in such case for adoption is as follows:—

Check for	£1	... 1
„	1/-	... − 1
„	1d.	... −11

This formula is referred to as the 19a System in Part IV., and must not be confused with the System in which double columns are used.

The chief reason for giving preference to the system of deducting pounds from shillings or *vice versa* instead of ascertaining the difference between shillings and pence and then multiplying by 11 is

because the difference in the check-figure of the addition in a Primary Record is more quickly ascertained by multiplying by -2 there being only three figures at most to deal with instead of four as in the case of multiplying by 10.

Base-number 19 (Original Formula).

The distinct advantage of the 19 base-number over any other base-number is:—

That the check for three figures in the pounds column can be more easily ascertained, *e.g.*

To ascertain the check-figure of £343 (base-number 19)

Add half of 34 to 3 = 20

∴ the check-figure is 1.

Take an odd amount for the first two figures, viz:—

£353.

Either deduct 19 from the first two figures which will convert an odd into an even figure, and then proceed as above, viz:—

Add half of 16 to 3 = 11

or,

add half of 35 to 3 = $20\frac{1}{2}$

and for each half add 10 *e.g.*

20 + 10 = 30 or 11

The principle on which the check-figure for

three figures in the pounds column is so quickly obtained may be stated as follows:—

The check-figure for each unit is 1
" " " " ten is 10
" " " two tens is ∴ 20=1

Check-figure for		*Check-figure for*
Two tens	=	1 unit
∴ Three "	=	$1\frac{1}{2}$ units
∴ Four "	=	2 "

It is obvious therefore:—

That if the number of tens be divided by 2, and the quotient added to the number of units, the check-figure for any amount in the pounds column over £100 and under £1,000 can be quickly obtained.

To ascertain the check-figures of amounts in the pence column:—

Multiply pence by 8 or −11. The latter method will be found simpler after noting the check-figure for each number in the pence column ascertained thus:—

All Negative Checks.

	C.F.		C.F.
1= 11	or 11 ...	2= 22	or 3
3= 33	or 14 ...	4= 44	or 6
5= 55	or 17 ...	6= 66	or 9
7= 77	or 1 ...	8= 88	or 12
9= 99	or 4 ...	10=110	or 15
11=121	or 7		

Observe :—

That the check-figure of any *even* number of pence is half as much again as that figure.

That only the check-figures of odd numbers require to be learned.

HINTS ON LEARNING THE CHECK-FIGURES OF ODD-FIGURES IN THE PENCE COLUMNS.

Place the following figures conspicuously on a piece of paper thus :—

1 7 11 1

The check-figure of each of these numbers of pence is the figure immediately preceding.

After committing to memory in this order write down the following :—

1/7	4/9
7/11	14/3
11/1	17/5

The figures in the latter column are introduced at this stage, and *in this form*, in order that the reader may learn the check-figures of the other odd numbers in the pence column, viz :—

	9	3	5
check-figure	4	14	17

and at the same time remember that when any of the above shillings and pence are posted to the Ledger the check-figure in each case is o. When these amounts appear along with any

number of pounds the check-figure of the pounds will be the check-figure of the amount.

It will be noticed that each of these amounts is a multiple of 19, and that if the even numbers are treated in the same manner viz:—

3/2	12/8
6/4	15/10
9/6	

all the multiples of 19 under 19/0 which may appear in the shillings and pence columns (unless half-pence are allowed) will be detected at once, and in many instances this will reduce the calculation, *e.g.*

(1). Required the check-figure of	£233	17	6
Deducting the multiple	0	17	5
The amount immediately appears to the Bookkeeper as	233	0	1

Multiply pence by 8 and add the product to pounds, or

Multiply pence by −11 and deduct the product from pounds, *e.g.*

233+ 8=241 *i.e.* 13 (half of 24=12+1=13)
or 233−11=222 *i.e.* 13 (half of 22=11+2=13)

The check-figure of £233 17 6 is 13.

(2)	Required the check-figure of	£193	4	9
	Deducting the multiple	0	4	9
		£193	0	0
	and also deducting the multiple	190	0	0
	this large amount should at once appear to the Bookkeeper as the check-figure of which is 3	3	0	0
(3)	Required the check-figure of	587	5	9
	Deducting the multiples of 19	570	4	9
	the Bookkeeper, after a little practice, will calculate this large amount as	17	1	0

the check-figure of which is $17+1=18$.

NOTE:—For large amounts in the pounds column the positive check should be adopted for debits. For small amounts in the pounds column the negative check should be adopted for debits.

The negative check need not have a minus before it, as the bookkeeper determines at the outset whether the result for debits in the Ledger is to be positive or negative.

HOW TO ASCERTAIN THE NEGATIVE CHECK.

For small amounts:—

Multiply the number of pence by 11 and deduct the sum of the figures appearing in the pounds and shillings columns.

For large amounts:—

Multiply the number of pence by 11 and deduct the check-figure of the pounds and shillings.

(1). Required the negative check of £6 3s. 7d.

Mental process:—

$$6 + 3 = 9$$
$$77 - 9 = 68 \textit{ i.e. } 11$$

The negative check-figure of £6 3s. 7d. is 11.

(2). Required the negative check of £176 5s. 3d.

Mental process:—

$$176 + 5 = 181 \textit{ i.e. } 10$$
$$33 - 10 = 23 \textit{ i.e. } 4.$$

The negative check-figure of £176 5s. 3d. is 4.

NOTE:—In the above calculations no multiplication is necessary as the Bookkeeper mentally places the same figure shown in the pence column immediately after that figure, *e.g.* £6 3s. 7 7d. and calls 11 always 7 and 10 always 15.

Errors under Class 5.

Posting £123 as

F.	£132	Difference £	9.
G.	231	,,	108.
H.	213	,,	90.
I.	312	,,	189.
K.	321	,,	198.

The difference caused by each transposition is a multiple of 9.

Write down the multiples of 9 thus:—

1	9	14	126	28	252
2	18	15	135	29	261
3	27	16	144	30	270
4	36	17	153	31	279
5	45	18	162	32	288
6	54	19	171	33	297
7	63	20	180	34	306
8	72	21	189	35	315
9	81	22	198	36	324
10	90	23	207	37	333
11	99	24	216	38	342
12	108	25	225	39	351
13	117	26	234	40	360
		27	243		

Dividing each of these multiples by the base-numbers, 7, 14, 13, 17 and 19 we find that transpositions which create the following differences will not be detected by the respective base-number adopted, viz.

Base-number 7	...	63	126	189	252	315
Base-number 14	...	126	252			
Base-number 13	...	117	234			
Base-number 17	...	153	306			
Base-number 19	...	171	342			

Differences which are multiples of these numbers will also not be detected.

Proceeding in the same manner as indicated on page 18 for transpositions of pounds, shillings and pence, the results of our investigations may be classified as follow:—

SCHEDULE F.

Transposition of the last two figures in the pounds column.

Difference always a multiple of 9 and the multiple is obtained from the difference between the two figures transposed, *e.g.*

$$(3-2)\times 9=9$$

SCHEDULE G.

Transposition of three figures.

Hundreds as units.
Tens as hundreds.
Units as tens.

Difference always a multiple of 9 and is obtained as follows:—

(1) Subtract the tens and units from the same figures if transposed in the same order as hundreds and tens, *e.g.*

$$230-23=207$$

(2) Subtract the figure shown as hundreds from the same figure multiplied by 100, *e.g.*

$$100-1=99$$

(3) The difference between (1) and (2) is the required multiple of 9, *e.g.*

$$207 - 99 = 108$$

Observe :—

That the multiple of 9 derived from the first calculation is exactly 9 times the tens and units.

That the multiple of 9 derived from the second calculation is a multiple of 99.

Schedule H.

Transposition of the first two figures.

Difference is a multiple of 90 and the multiple is obtained from the difference between the hundreds and tens, *e.g.*

$$(2 - 1) \times 90 = 90$$

Schedule I.

Transposition of three figures.

Hundreds as tens.
Tens as units.
Units as hundreds.

Difference always a multiple of 9 and is obtained as follows :—

(1) Subtract the first two figures from the same figures multiplied by 10, *e.g.*

$$120 - 12 = 108$$

(2) Subtract the last figure from the same figure multiplied by 100, *e.g.*

$$300 - 3 = 297$$

(3) The difference between (1) and (2) is the required multiple of 9, *e.g.*

$$297 - 108 = 189.$$

Observe :—

That the multiple of 9 derived from the first calculation is exactly 9 times the first two figures.

That the multiple of 9 derived from the second calculation is a multiple of 99.

Schedule K.

Transposition of first and third figures.

Difference is a multiple of 99 and the multiple is obtained from the difference between the first and third figures, *e.g.*

$$(3 - 1) \times 99 = 198$$

Errors in Schedule F.

The highest figure being 9 and the lowest 0, the greatest difference will be caused by the transposition of 09 as 90, *i.e.* 81.

The base-number 7 is the only number on page 31 which shows a difference less than 90, viz. 63, and consequently the following transpositions of the last two figures in the pounds

column will not be detected by this base-number, viz:—

07	posted	as	70	and *vice versa*
18	„		81	„
29	„		92	„

Errors in Schedules G and I.

The method adopted in order to ascertain the number of possible mispostings which will not be detected by using the various base-numbers under Schedules G. and I. is shown in Part IV.

Errors in Schedule H.

As the differences in this Schedule are multiples of 90, the base-numbers 7 and 14 are the only numbers which will not detect every transposition. The two figures transposed must differ by 7, *e.g.*

071	posted	as	701	and *vice versa*.
181	„		811	„
291	„		921	„

Errors in Schedule K.

As the differences in this Schedule are multiples of 99, the base-number 7 is the only number which will not detect transpositions of the first and third figures. (See Part IV., Schedule G., under "Hundreds.") The two figures transposed must however differ by 7, *e.g.*

047	posted	as	740	and *vice versa*.
148	„		841	„
249	„		942	„

Errors under Class 6.

Posting the last figure in the pounds or shillings column in the next column,

or

Posting the first figure in the shillings or pence column in the preceding column.

Errors of this nature may be classified as follows:—

Schedule B.

Most probable Errors.

Posting	£20	2	3	} difference	£2	0	9
as ...	22	3	0				
Posting	£30	2	3	} difference	£2	0	9
as ...	32	3	0				

Posting any multiple of £10 from

£20 to £90+	£0	2	3	} difference	£2	0	9
as £20 to £90+	2	3	0				

Schedule L.

Posting	£21	4	6	} difference	£18	10	0
as ...	2	14	6				

or *vice versa*

Schedule M.

Posting	11s.	1d.	} difference	9s.	2d.
as ...	1s.	11d.			

and

Posting	11s.	0d.	} difference	9s.	2d.
as ...	1s.	10d.			

or *vice versa*.

It will be obvious to the careful student of the previous pages that all the base numbers, 7, 14, 13, 17 and 19, will detect transpositions under Schedule M.

The differences shown under Schedule L are made up of a constant amount, viz: 10s., and a multiple of £9.

The method adopted for discovering the number of possible mispostings which will not be detected by using the various base-numbers under Schedule L. is shown in Part IV.

The errors which are classified under Schedule B. are referred to in the List of Most Probable Errors appearing in Part IV.

Fractions.

To ascertain the check-figures of fractions:

(1) Ascertain the check-figures of numerator and denominator.

The highest number shown as numerator or denominator in the 19 system will then be 18 and the lowest number 0.

If the check-figure of the numerator is 0 the check-figure of the whole fraction is 0.

If the check-figure of the denominator is 0 the check-figure of the whole fraction is infinity, which for check-figure purposes must be represented by 0.

Prepare tables for any system on the following lines:—

Base-number 19.

The check-figure of 1 is $1 = 20$

" $\frac{1}{2}$ " $\therefore = 10$

" $\frac{1}{4}$ " $\therefore = 5$ or 24

" $\frac{1}{8}$ " $\therefore = 12$

" $\frac{1}{16}$ " $\therefore = 6$

If the check-figure of $\frac{1}{16}$ is 6

$\therefore$ " $-\frac{1}{3}$ is 6

$\therefore$ " $\frac{1}{3}$ is -6 or 13

Similarly,

	Complements of base-number.
As $\frac{1}{2} = 10$	$\frac{1}{17} = 9$
" $\frac{1}{4} = 5$	$\frac{1}{15} = 14$
" $\frac{1}{8} = 12$	$\frac{1}{11} = 7$

Proceed as follows:—

The check-figure of $\frac{1}{3}$ is 13 or 32

" $\frac{1}{6}$ " $\therefore$ 16

" $\frac{1}{12}$ " $\therefore$ 8

" $\frac{1}{24}$ or $\frac{1}{8}$ " $\therefore$ 4

" $\frac{1}{10}$ " $\therefore$ 2

" $\frac{1}{20}$ or $\frac{1}{1}$ or 1 " $\therefore$ 1

	Complements of base-numbers.
If $\frac{1}{3} = 13$	$\frac{1}{16} = 6$
$\frac{1}{6} = 16$	$\frac{1}{13} = 3$
$\frac{1}{12} = 8$	$\frac{1}{7} = 11$
$\frac{1}{5} = 4$	$\frac{1}{14} = 15$
$\frac{1}{10} = 2$	$\frac{1}{9} = 17$ or 36
	$\therefore \frac{1}{18} = 18$

Re-arrange in order thus:—

The check-figure of	$\frac{1}{2}$	is	10
,,	$\frac{1}{3}$	,,	13
,,	$\frac{1}{4}$	,,	5
,,	$\frac{1}{5}$	,,	4
,,	$\frac{1}{6}$	,,	16
,,	$\frac{1}{7}$	,,	11
,,	$\frac{1}{8}$	,,	12
,,	$\frac{1}{9}$	,,	17
,,	$\frac{1}{10}$	,,	2
,,	$\frac{1}{11}$	,,	7
,,	$\frac{1}{12}$	,,	8
,,	$\frac{1}{13}$	,,	3
,,	$\frac{1}{14}$	,,	15
,,	$\frac{1}{15}$	,,	14
,,	$\frac{1}{16}$	,,	6
,,	$\frac{1}{17}$	,,	9
,,	$\frac{1}{18}$	,,	18

Observe:—

That the calculations may be curtailed by noting the following:—

If $\frac{1}{2} = 10$ $\frac{1}{10} = 2$

$\frac{1}{4} = 5$ $\frac{1}{5} = 4$

The same principle applies to similar equations.

The check-figure of any fraction in the 19 system may be quickly ascertained by using the above table, *e.g.*

Required the check-figure of $\frac{131}{273}$

The check-figure of 131 is 17

„ 273 is 7

$\therefore$ „ $\frac{131}{273} = \frac{17}{7}$ or $2\frac{3}{7}$

As $\frac{1}{7} = 11$; $\frac{17}{7} = 11 \times 17 = 187$

$\therefore$ check-figure = 16

Or using the whole number:—

$\frac{3}{7} = 11 \times 3 = 33$ or 14

2	=	2
$\therefore 2\frac{3}{7}$	=	16

If the same method is adopted with base-number 14 it will be obvious that the adoption of *even* numbers as base-numbers would necessitate the use of fractions in the check-figure column.

Concluding Remarks.

Before deciding on any particular base-number, study the number of errors shown in Part IV., and as the number of possible mis-postings is not even reduced to a minimum by the adoption of as large a base-number as 19 treated according to the device already suggested as the only means of avoiding an additional check-figure column, reflect well before disparaging the idea of a double column. This double column will materially assist you in balancing your Ledgers, and in discovering any error in the trial

balance which would have been detected earlier but for the strong tendency in an unguarded moment of placing the check-figure in the wrong column in the Ledger. As the Primary Records will be carefully looked over from time to time (not absolutely necessary, though preferable, when additions are made) all errors of transposition of pounds and shillings columns can speedily be detected *then*, or supposed errors of transposition, through using the wrong column, rectified by reference to the Ledger.

Again, when a Ledger Account is balanced, is it exacting too much of your time to carefully examine each debit and credit to ensure that you have placed the check-figure of each amount, *actually* posted, in the correct column?

Further, the customer will generally help you to find any such transpositions or you will detect most of the transpositions in a Bought Ledger when the accounts rendered are being checked for settlement. The lowest possible difference being 19/- you are almost certain to have your attention called to the error during the earlier part of your financial period, and consequently, when extracting the Ledger balances, it will naturally occur to you to examine the double columns carefully in order to secure a correct trial balance as far as possible. On the other hand, if it has been a transposition of one amount,

or of several amounts, which may be classed under Schedules B, D and E already referred to, it will be very difficult to determine how the error is made up, unless the trial balance is simply out on account of a single transposition of this nature during the period. (See Part V. for some assistance in detecting such errors). Remember that the adoption of the original, instead of the amended, formula for the base-number 19, *without the use of double columns*, protects you substantially from all errors other than transpositions of pounds and shillings, and consequently the trial balance, if incorrect, will generally be out to the extent of some multiple of 19/- This means that the pence column need not be examined at all in order to detect the mistake, and in most instances the examination of the Primary Records will be restricted to amounts under £20.

Mr. Stewart Green, A.C.A., of Sheffield, in a letter to the Editor of "The Accountant" dated February 12th, 1907, relates a peculiar experience which should be borne in mind by all firms using a Check Figure System. A trial balance showed a difference of £2 12s. which had not been detected by the use of the base-number 13. Obviously 52/- is a multiple of 13, and the check-figure is therefore 0. The error was found in an addition of the discount column in the Cash Book.

Similarly, any *addition* which is wrong to the extent of a multiple of the base-number adopted by the bookkeeper cannot be detected by any Check Figure System. In the 19 system this would mean an error of 1/7 or any multiple of 1/7, and this fact clearly demonstrates *the necessity of the auditor's verification of every addition*, notwithstanding a Check Figure System is in use in the firm whose accounts are under investigation.

In large concerns, where the books are regularly balanced, the auditor must necessarily satisfy himself that the additions of the Primary Records, the totals of which are shown in the Sectional Ledger Accounts submitted to him by the accountant, are strictly accurate; and as such work cannot be performed in the short interval generally allowed between the date of the balance sheet and the date of the auditor's certificate, there need be no fear of such a mistake occurring where the auditor's staff periodically check such additions, and verify the transfers from the Primary Records to the Private Journal or Ledger.

PART II.

Practical application of the principles explained in Part I., using the processes with base-number 7 to show, in the simplest manner, how the Check Figure System is applied to Account Books.

Base-number 7.

I.—Posting Primary Records to Ledger.

Sales Journal.

			Ledger Folio.	£	s.	d.	Check-figure in Ledger.
(1)	A.B.	Tunstall	29	17	3	5	6
(2)	C.D.	Burslem	35	6	8	9½	1
(3)	E.F.	Hanley	67	0	12	4	4
(4)	G.H.	Stoke	93	9	0	6	5
(5)	J.K.	Fenton	169	37	18	11½	2
(6)	L.M.	Longton	185	3	5	7	5
(7)	N.O.	Leek	203	18	5	2	0
			Total	£92	14	9	2

In the above postings, there are 2 half-pence, and it simplifies the calculations considerably, with this base-number, if the amounts are reduced to farthings, *e.g.*

£1 = 960 farthings
1/- = 48 „
1d. = 4 „
½d. = 2 „
¼d. = 1 „

Dividing each of these figures by 7 the respective remainders are as follow :—

For each	£1	1
„ „	1/-	6
„ „	1d.	4
„ „	½d.	2
„ „	¼d	1

As one of the principal features of a Check Figure System is to arrive at the remainder or "check" as quickly as possible, it is imperative that a base-number should be adopted which will enable the bookkeeper to shorten the mental calculation as much as possible, and in the following pages only base-numbers which effect this purpose are dealt with.

Observe :—

That the remainder or "check" for 1/- is 6

The "check" for £1 0 0 is 1
„ 0 1 0 is 6

∴ „ £1 1 0 is 7 or 0

The check for 1/- is therefore equivalent to −1 (6 from 7 leaves 1).

That the pounds, pence, halfpence and farthings are all positive and that the shillings are now converted into negative checks, the formula being as follows :—

Check-figure for each	£1	1
„	„ 1/-	−1
„	„ 1d.	4
„	„ ¼d.	1

If the pounds are added to four times the pence, halfpence and farthings (done by one calculation) and the result is less than the number of shillings, the difference being *negative* must be deducted from the base-number 7, or a multiple of 7, to obtain a positive check.

The check-figure for the pence column may be arrived at by a quicker process, but until the reader has learned the principles, it is inexpedient to use such process.

Application of Principles.

(1) A.B. Tunstall £17 3s. 5d.

Mental Process :—

$$17-3=14+(5\times4)=34$$

Divide 34 by 7: leaves 6

The check-figure of £17 3s. 5d. is 6.

Explanation.

£1 (or 960 farthings) divided by 7 leaves 1

∴ £17 will leave 17 or 3, *e.g.*

$$\frac{960\times17}{7}=\frac{16320}{7}=2331\tfrac{3}{7}$$

Similarly 3/- = −3
as 1/- = −1
and 5d. = 20
as 1d. = 4

When the figures in the Primary Records are small, it is unnecessary to throw out the multiples of 7 until the final total is obtained.

The check-figure is ascertained *after* posting to the Ledger, otherwise the whole effect of the system is nullified, as the main object is to be able to ascertain, *as soon as each page in the Sales Journal or other Primary Record is added*, whether all postings to the Ledger have been accurately performed.

Place the check-figure "6" immediately to the right of the £17 3s. 5d. in the Ledger and whether this figure is right or wrong, place the *same figure* in the Sales Journal or Primary Record also to the right. If the Ledger folio is on the right, the left side should be used.

(2) C.D. Burslem £6 8s. 9½d.

Here the shillings are greater than the pounds. The result, therefore, so far as these two figures are concerned, will be *negative*. The negative results must be deducted from the positive (as in this system a *positive* has been chosen as the easiest for mental calculation). The bookkeeper

in this case has only to remember to *deduct* 2 from $9\frac{1}{2}$d. $\times 4$, *e.g.*

$$6-8= -2+38=36=1$$

(3) E.F. Hanley 12/4

Multiply the pence by 4

$$4\times 4=16$$

Deduct the shillings 12

4

In some systems it is very awkward to ascertain the "check" on account of the check-figure for pence being 1, or -1, and the shillings (the sign of which is the reverse of pence) being *greater* than the pence. It is necessary, in such cases, to add the base-number, or a multiple of the base-number, to the pence *before* deducting the shillings, or to deduct the shillings from the next higher multiple and add the pence.

(4) G.H. Stoke £9 0s. 6d.

Mental process:—

$$9+(6\times 4)=33$$

Divided by 7 leaves 5

(5) J.K. Fenton £37 18s. $11\frac{1}{2}$d.

Mental process:—

$$37-18=19+(11\tfrac{1}{2}\times 4)=65$$

Divided by 7 leaves 2

The bookkeeper, after a little practice, reckons thus:—

$$19+46=65 \textit{ i.e. } 2$$

(6) L.M. Longton £3 5s. 7d.
3 − 5 = −2 + 28 = 26 *i. e.* 5

Bookkeeper simply says:—
2 from 28 = 26 *i. e.* 5

(7) N.O. Leek £18 5s. 2d.
13 + 8 = 21 *i.e.* 0

Proceed, as above indicated, until the whole of the page is posted into the Ledger, remembering that the check-figure must be calculated *only* in the Ledger, and whatever figure is recorded *in the Ledger* must be placed opposite its corresponding item in the Primary Record, otherwise the System is of no use.

(8) Total £92 14s. 9d.

We have now arrived at the stage when we can be fairly satisfied that all our postings to the Ledger are correct.

If the check-figure of the total agrees with the addition of the check-figure column (after throwing out the multiples of 7) *time is saved* for the present, until the trial balance discloses whether our base-number has been sufficiently reliable, assisted in all probability by the *general* accuracy of the bookkeeper, who dislikes the auditor finding any mistakes in his postings

For it satisfies the bookkeeper

(1) That his addition is correct

(2) That all his postings to the Ledger are arithmetically accurate.

The check-figure of £92 14s. 9d. is 2 which agrees with the total of the check-figure column after throwing out the multiples of 7.

Assume, however, that the Invoice to A.B. for £17 3s. 5d. has been posted to the *credit* in the Ledger instead of to the debit, how is the book-keeper to detect this? Simply by reversing the "check" when posting credits.

A *positive* check having been decided upon as more suitable for the majority of the calculations which, in most concerns, are generally postings to the debit in the Ledger,

A *negative* check should be adopted for credits in the Ledger.

Instead of 6 appearing in the Day Book the positive check should have been deducted from the base-number 7 and the figure 1 should have appeared in the Ledger.

The reader may say that it is very improbable that he would be calculating "Negative Checks" when posting from the Day Book. How is the error then to be detected?

When the additions in the Ledger are performed, the same check-figure used when posting from the Sales Journal will not agree with the total of A.B.'s account on the *credit side of the Ledger*: it will be 5 out, because 6 has been placed against A.B.'s credit (actually a debit) of

£17 3s. 5d. in the Ledger, and when posting *credits* from such records as Cash and Remittance Books, and also from Credit Journals for Returns, Allowances and Commissions, the *negative check* is used in the same manner as the *positive check* is maintained while posting from a Day Book.

How to ascertain the Negative Check.

Example (1) £10 3s. 6d.

Maintain the positive style, but do not throw out the multiples of 7, *e.g.*

$$10-3=7+(6\times4)=31$$

Take 31 from next higher multiple of 7 *i.e.* 35

leaves negative check 4

Example (2) £3 11s. 0d.

3 from 11 is 8

∴ negative check-figure is 1

If the check for shillings is greater than the check for pounds and pence, the result is *negative* and therefore need not be deducted from the next higher multiple of 7.

II.—Application of System to Ledger Accounts.

A positive check has been used for debits.

A negative check has been used for credits.

How are these checks to be reconciled when balancing a Ledger Account?

C.D. BURSLEM.

Dr.								Cr.							
1907			S.J.	£	s.	d.	C.F.	1907			C.J.	£	s.	d.	C.F.
Jan. 3.	To	Goods	136	6	8	9½	1	Mar. 4.	By	Returns	14	2	6	3	6
„ 4.		„	137	3	2	5	0	„ 31.	„	Cash	C.B. 13	261	11	1	5
„ 5.		„	138	17	18	10½	6	„ 31.	„	Dis.	J. 16	11	16	0	5
„ 19.		„	143	236	7	3	3								
Mar. 31.	To	Cash	C.B. 13	11	16	0	2								
				£275	13	4	5					£275	13	4	2

In the specimen Ledger Account shown on preceding page all the debits have been calculated by using the positive check, and the credits by using the negative check.

After adding each column and throwing out the multiples of 7, the positive check on debit side 5
will require
a negative check on the credit side of 2
—
to obtain the complement of 7
or, in other words,
the negative check, having been used instead of a positive check, in the first instance, to facilitate the discovery of errors in posting debits for credits and *vice versa*, should now be converted mentally into a positive check by deducting the negative check from the base-number 7 in order to agree with the check-figure opposite the total on the debit side of the Ledger.

How are Balances in the Ledger to be treated?

In the specimen Ledger Account shown on the following page you will observe that the debit balance of £235 17s. 6½d., being first of all entered on the credit side, has the negative check 1, and when brought down to the debit side, has the positive check 6.

By this simple process, the bookkeeper is almost unconsciously prevented from bringing the balance down on the wrong side. Once he is accustomed

Dr. E.F. HANLEY. **Cr.**

1907		S.J.	£	s.	d.	C.F.	1907		C.J.	£	s.	d.	C.F.
Jan. 3.	To Goods	136	106	3	9	6	Jan. 15.	By Returns	5	40	6	0	1
„ 5.	„	138	52	6	7½	6	„ 17.	„ Empties	J. 17	3	0	0	4
„ 9.	„	140	20	5	8	5	„ 31.	„ Cash	C.B. 7	100	0	0	5
„ 11.	To Bill retd.	B.B. 73	200	0	0	4	„ 31.	„ Balance	c/d	235	17	6½	1
„ 11.	To Expenses on Bill	C.B. 7	0	7	6	3							
			£379	3	6½	3				£379	3	6½	4
Jan. 31.	To Balance b/d		£235	17	6½	6							

to treating the check for balances in this manner, it is very improbable that the *same* check-figure will be used when a balance is brought down, and consequently, any small credit balance, for instance, in a Sales Ledger, which has been inadvertently brought down to the *debit* instead of the *credit* side, will be rectified either at the next settlement of the account or at the end of the financial period; for the reverse check-figure, which in this case is negative, will be added with positive checks and the total will not agree with the check-figure of the total debits when balancing the subsequent account.

Will the Check Figure System detect balances which have not been brought down?

It is generally admitted that there is a grave liability to error in this respect, and it is surely worth while therefore to take a little extra trouble to ensure balancing at once when making a

Trial Balance.

A Trial Balance will not agree if sundry balances are omitted. Why not, therefore, use the check-figures, which are easily noted, by copying the checks of the total debits and credits, when any account is ruled off, in a separate memorandum book for each Ledger in this manner:—

Sales Ledger (London Accounts).

DEBIT BALANCES.					CREDIT BALANCES.				
Led. folio.	A	B	C	D	Led. folio.	A	B	C	D
	Dr.	Cr.	c/d	b/d		Dr.	Cr.	c/d	b/d
137	5	2	—	—	142	4	2	1	6
138	3	3	1	6	143	1	4	2	5
136	2	2	3	4	144	3	3	1	6
140	2	5	—	—	145	2	0	5	2
141	6	0	1	6	146	6	1	—	—
Total	18	12	5	16		16	10	9	19
Check Figure	4	5	5	2		2	3	2	5

Totals of columns A, B and C added together should equal a multiple of 7 *i.e.* 0.

Totals of columns C and D added together should equal a multiple of 7 *i.e.* 0.

By recording these small figures in the special memorandum book when any account is ruled off, a considerable amount of time may be saved at the end of each financial period, for not only is it possible by adopting this simple method to ascertain whether an error in the trial balance is confined to the debit or credit side of the Ledger, but it is also extremely probable, with a careful

bookkeeper, that the check-figure of the debit or credit balance required will represent one balance which has not been brought down, and the scrutiny of the latest folios in this memorandum book will materially assist in tracing the missing balance. Where systems are in use for balancing each Ledger separately, the idea of keeping separate memoranda books for each Ledger is obvious.

The debit and credit balances shown on the trial balance should have the same check-figure as appears in the Ledger *after* the balances are brought down. The addition of the check-figure columns in the trial balance will not agree if an error has been made when extracting the Ledger balances.

All the entries in the Primary Records may be summarised as follow:—

Dr, SALES LEDGER ACCOUNT. Cr.

1907	Ref. Folio.	£	s.	d.	c.f.
Jan. 1					
To Balances @ Dr.		5634	2	8	1
June 30					
„ Sales		22301	5	4	3
June 30					
„ Journal Entries		206	8	9	3
June 30					
„ Cash		813	11	7	4
June 30					
„ Petty Cash ...		2	5	10	2
		£28957	14	2	6
June 30					
To Balances	b/d	£6143	2	11	4

1907	Ref. Folio.	£	s.	d.	c.f.
Jan. 1					
By Balances @ Cr.		73	5	4	0
June 30					
„ Returns and Allowances ...		963	2	5	6
„ Journal Entries		1165	8	9	4
June 30					
„ Cash		20600	7	4	6
June 30					
„ Petty Cash ...		12	7	5	3
„ Balances ...	c/d	6143	2	11	3
		£28957	14	2	1

Total Credits = 5

To be reconciled with actual Led. balances.

Actual Ledger Balances.

	£	s.	d.
Debit balances ...	6840	3	6
Credit balances ...	697	0	7
	6143	2	11

Assume that this General Sales Ledger Account is simply one customer's account, and that the credit balances at the commencement of the period are treated as Credit Journal postings, the entries which would be made in the special memorandum book are as follow:—

Column A Dr. 6
„ B Cr. 5 } = 14 a multiple of 7
„ C c/d 3
„ D b/d 4 } = 7

The check-figure of the total *debits* posted during the financial period may be reconciled as follows:—

Check-figure of col. A − check-figure of col. D*

minus

The check-figure of the debit balances as per trial balance at the commencement of the financial period.

plus

The check-figure of the debit balances as per trial balance at the end of the financial period.

* Debit balances only. The debit balances at the commencement of each account should be included as debit postings in column A.

The check-figure of the total *credits* posted during the financial period may be reconciled as follows:—

Check-figure of col. B—check-figure of col. D*

minus

The check-figure of the credit balances as per trial balance at the *beginning* of the period

plus

The check-figure of the credit balances as per trial balance at the *end* of the period.

Total debits posted to Sales Ledger:—

	C.F.
Sales Journal entries	3
Journal entries ...	3
Cash entries ...	4
Petty Cash entries...	2
	12=5

Total credits posted to Sales Ledger:—

Returns and Allowances	6
Journal entries ...	4
Cash entries	6
Petty Cash entries ...	3
	19=5

If the accounts are not ruled off before extracting the balances, it will be necessary to take out the debits and credits, shown in each account, separately.

* Credit balances only. The credit balances at the commencement of each account should be included as credit postings in column B.

Dr. BOUGHT LEDGER ACCOUNT. Cr.

1907	Ref. Folio.	£	s.	d.	c.f.
Jan. 1					
To Balances @ Dr....		26	3	9	3
June 30					
„ Overcharges, Rets. & Allowances		114	7	2	3
June 30					
„ Journal Entries...		28	5	6	5
June 30					
„ Cash		8000	2	5	3
June 30					
„ Petty Cash ...		123	3	11	3
June 30					
„ Balances... ...	c/d	1442	6	10	6
		£9734	9	7	2

To be reconciled with actual Led. balances.

1907	Ref. Folio.	£	s.	d.	c.f.
Jan. 1					
By Balances @ Cr.		1500	6	8	0
June 30					
„ Purchases ...		7608	3	4	2
June 30					
„ Journal Entries		593	4	3	1
June 30					
„ Cash		17	8	9	4
June 30					
„ Petty Cash ...		15	6	7	5
		£9734	9	7	5
June 30					
By Balances ...	b/d	£1442	6	10	1

Actual Ledger Balances.

	£	s.	d.
Credit balances ...	1584	3	9
Debit balances ...	141	16	11
	1442	6	10

Proceed in the same manner as indicated under Sales Ledger Account to reconcile the postings to debit or credit in the Bought Ledger, if the actual balances do not agree with the balance shown by the summarised account.

Total credits posted to Bought Ledger:—

	C.F.
Purchases	2
Journal entries ...	1
Cash	4
Petty Cash... ...	5
	12=5

Total debits posted to Bought Ledger:—

Overcharges, Returns, and Allowances ...	3
Journal entries ...	5
Cash	3
Petty Cash	3
	14=0

The Private Ledger Account and other abstracts are not shown here, as sufficient indication has been given of the advantages to be derived by keeping a special memorandum book.

PART III.

Formula for each Base-number explained.—Examples for ascertaining Positive and Negative Checks.—Particular devices suggested under each Base-number for speedily arriving at the Check-figure.—Special devices applicable to the 7 and 13 Base-numbers.—Multiplication by 10 suggested as a more uniform method for the treatment of Negative Checks.—The Check-figures of millions of pounds speedily arrived at by using Base-number 13.—Fractions utilised for ascertaining the Check-figures of large amounts with Base-numbers 17 and 19.

Base-number 7.

Formula :—

Check-figure	for each £1	...	1
„	„ 1/-	...	−1
„	„ 1d.	...	4

This formula has already been explained in Part II.

PARTICULAR DEVICES SUGGESTED FOR SPEEDILY ARRIVING AT THE CHECK-FIGURE.

(1) Check-figure of pence column.

(a) With base-number 7 to multiply by 4 is equivalent to multiplying by 11, 18, 25, and so on in arithmetical progression. *This principle applies to all base-numbers.*

(b) It is useful to remember to multiply by 11 when the number of shillings exceeds

the number of pounds and the remainder is greater than the number of pence multiplied by 4.

(c) For *even* numbers in the pence column the check-figure is always *half* the number of pence.

(d) For *odd* numbers multiply by 4 or 11 or *halve* the number of pence and add $3\frac{1}{2}$, (deduct $3\frac{1}{2}$ if the number of pence exceeds 7).

(2) Pounds and shillings columns.

Ascertain the difference between the number of pounds and the number of shillings. If the former is greater; *add* the difference to the number obtained by adopting any of the devices already suggested for calculating the pence column; if the latter, *deduct*.

(3) Guineas and half-guineas, being multiples of 7, may be deducted from the full amount, and the check-figure of the remaining shillings and pence need only be ascertained.

(4) Quick methods for ascertaining the check-figures of large numbers have been fully explained in Part I.

(5) For three figures in the pounds column it may be useful, in some instances, to

halve the first two figures and deduct the result from the last figure, but it may be found preferable to adhere strictly to the method shown in Part I., *e.g.*

(A) Required the check-figure of £345.

$$5-(\tfrac{1}{2} \text{ of } 34)= -12$$

Deduct 12 from next higher multiple to obtain a positive check.

$$14-12=2$$

$\therefore$ the check-figure is 2.

The method shown in Part I is preferable *in this case.*

(B) Required the check-figure of £129.

$$9-(\tfrac{1}{2} \text{ of } 12)=3$$

$\therefore$ the check-figure is 3.

(C) Required the check-figure of £257.

$$257=240+17$$

$$17-(\tfrac{1}{2} \text{ of } 24)=5$$

$\therefore$ the check-figure is 5.

The bookkeeper simply calculates the half of 25 and puts the remainder, 1, mentally before the 7 to make it 17.

SPECIAL ADAPTABILITY OF BASE-NUMBER 7 FOR TESTING THE ACCURACY OF COMPOUND ADDITIONS BY ADOPTING A SIMILAR DEVICE TO THAT SUGGESTED IN PART I., PAGE 22.

Amend the usual formula by adding 4 to the check-figure of each penny, *e.g.*

AMENDED FORMULA (7a SYSTEM).

Check-figure	for each	£1 ...	1
„	„	1/- ...	−1
„	„	1d. ...	1

Example:—

£	s.	d.	C.F.	MENTAL PROCESS.
236	3	4	6	*237 : 11 from 17 leaves 6
5	2	6	2	9 *i.e.* 2
† 63	9	5	3	−4=3 (positive)
17	5	4	2	16 *i.e.* 2
137	3	5	6	139 : 6 from 19 leaves 13 *i.e.* 6
27	6	8	1	29 *i.e.* 1
239	17	5	3	227 : 11 from 7= −4 *i.e.* 3
726	8	1	2	
		3/-		

To reconcile the check-figure of the total with the total of the check-figure column proceed as follows:—

(1) Use the original formula

$$726-8+(1\times4)=722$$

Ignore 700 : 22÷7 leaves 1

the check-figure of £726 8s. 1d. is 1.

(2) Note that 3 is carried forward to the shillings column and that the total number of pence to which 4 has been

* 236 minus 3 plus 4 equals 237.

† The multiple of 7, viz., £63 may be ignored.

added when ascertaining the check-figure by the amended formula is 37.

$$37 \times 4 = 148$$
$$8 - (\tfrac{1}{2} \text{ of } 14) = 1$$

∴ the effect produced on the total by using a process which alters the relative values of pounds, shillings and pence is + 1.

(3) Add the results obtained from processes (1) and (2)

$$1 + 1 = 2$$

The figure 2 agrees with the check of the total of the check-figure column, and the addition may therefore be considered to have been substantially tested.

This amended formula is not recommended for use in detecting errors in posting from Primary Records to Ledgers.

It is recorded here with the view of showing what may be accomplished by studying the principles of Check Figure Systems, and the necessity for including the various Schedules used for discovering errors which will be found in Part IV. This matter will be dealt with more fully under base-number 13. Unfortunately, the errors are so numerous with such a small base-number as 7 that this

UNIQUE SYSTEM, viz.

using the figures in the pounds, shillings and

pence columns, without any further calculation, cannot be recommended except for the purposes of verifying the additions of Stock Sheets, Cash Sales and other records.

For verifying percentage calculations, simple multiplications and divisions, the base-number 7 should prove more effective than casting out the 9's.

Base-number 14.

Formula :—

Check-figure	for each	£1	...	2
„	„	1/-	...	−2
„	„	1d.	...	1

Formula arrived at as follows :—

				C.F.
£1 = 240	pence.	240 ÷ 14 = 17	and leaves	2
1/- = 12	„	12 ÷ 14 = 0	„	12 or −2
1d. = 1	„	1 ÷ 14 = 0	„	1

To ascertain the check-figure of any amount :—

1.—Positive Checks.

If the number of pounds exceeds the number of shillings, *add* the difference multiplied

by 2 to the number of pence and throw out the multiples of 14, *e.g.*

Required the check-figure of £17 15s. 8d.

$17-15=2 : 2\times2=4 : 4+8=12$

$\therefore$ the check-figure is 12.

If the number of shillings exceeds the number of pounds multiply the difference by 2 and *deduct* the product from the number of pence if the product is less than that number, or *deduct* the number of pence from the product and ascertain the difference between this remainder and 14 or the next higher multiple of 14, *e.g.*

(1) Required the check-figure of £11 13s. 9d.

$13-11=2 : 2\times2=4 : 9-4=5$

$\therefore$ the check-figure is 5

(2) Required the check-figure of £2 19s. 1d.

$19-2=17 : 17\times2=34$

34 from 1 = −33

Next higher multiple $42-33=9$

$\therefore$ the check-figure is 9.

2.—Negative Checks.

As the check-figure 7 will require to be shown as 7 when ascertaining negative checks by the process generally adopted, it is advisable, with this base-number, to multiply each positive check by 10 *i.e.* simply place 0 at the end of the check-figure.

This consideration of one of the effects produced by using a composite number may lead to the general adoption of a uniform o at the end of each negative check, so that the posting of a debit on the credit side of a Ledger account and *vice versa* may be detected, *before* an account is actually ruled off, in the Ledger, or by an occasional scrutiny of the Primary Records, the figure 10 being the only figure common to both sides of the Ledger.

PARTICULAR DEVICES SUGGESTED FOR SPEEDILY ARRIVING AT THE CHECK-FIGURE.

Guineas and half-guineas, being multiples of 14, may be deducted from the full amount, and the check-figure of the remaining shillings and pence need only be ascertained.

Base-number 13.

Formula :—

Check-figure for each £1	...	−1
„ „ 1/-	...	−2
„ „ 1d.	...	2

Formula arrived at as follows;—

£1 = 480 half-pence 480 ÷ 13 = 36 and leaves 12 or −1
1/- = 24 „ 24 ÷ 13 = 1 „ 11 or −2
1d. = 2 „ 2 ÷ 13 = 0 „ 2 *i.e.* +2

To ascertain the check-figure of any amount:—

1.—Negative Checks.

Negative Checks are considered first, in this case, as the pounds and shillings are both negative, and the bookkeeper therefore determines that negative checks shall be used for debits (if debits are more numerous) and positive checks for credits; or in other words, he instantly converts the above formula as follows:—

Check-figure for each £1 ... 1
„ „ 1/- ... 2
„ „ 1d. ... −2

Required the check-figure of a debit of £16 13s. 4d.

$(13-4)\times 2 = 18+16 = 34$ *i.e.* 8.

∴ the check-figure is 8.

2.—Positive Checks.

Required the check-figure of a credit of £16 13s. 4d.

$(13-4)\times 2 = 18+16 = 34.$

Next higher multiple $39-34 = 5$

∴ the check-figure is 5.

Consider the suggestions under base-number 14 for the treatment of credits.

Note that this formula facilitates the calculations of firms using half-pence in their Ledgers.

PARTICULAR DEVICES SUGGESTED FOR SPEEDILY ARRIVING AT THE CHECK-FIGURE.

When the figures in the shillings and pence columns are the same, the check-figure of the pounds column need only be ascertained.

For three figures in the pounds column

(1) Multiply the hundreds by 9 and *add* to the last two figures considered as units, or

(2) Multiply the hundreds by 4 and *deduct*.

(3) When the first two figures are exactly divisible by 4 add the quotient to the last figure.

Examples :—

(1) Required the check-figure of £405.

$4 \times 9 = 36 + 5 = 41$ *i.e.* 2

(2) Required the check-figure of £157.

$1 \times 4 = 4$

$57 - 4 = 53$ *i.e.* 1

(3) Required the check-figure of £364.

$36 \div 4 = 9 + 4 = 13$ *i.e.* 0

It is preferable to use the first process when the last two figures do not exceed 36, but some bookkeepers may prefer to use the third process throughout, in which case the check for the following fractions must be learned, viz :—

$\frac{1}{4} = 10$, $\frac{1}{2} = 7$, $\frac{3}{4} = 4$

For £257 the process is $\frac{25}{4}=6\frac{1}{4}+7=13\frac{1}{4}$ *i.e.* $\frac{1}{4}=10$

„ 269 „ $\frac{26}{4}=6\frac{1}{2}+9=15\frac{1}{2}$

$=15+7=22=9$

„ 278 „ $\frac{27}{4}=6\frac{3}{4}+8=14\frac{3}{4}$

$=14+4=18=5$

It is obvious that the base-number 19 enables the calculations of three figures to be done more quickly, but the base-number 13 is particularly adapted for larger figures.

For large amounts the process is almost identical with that shown in Part I. for base-number 7, *e.g.*

(1) Required the check-figure of £163,204,342.

From 204 take 163 leaves 41

„ 342 „ 41 „ 301

$3\times9=27+1=28$ *i.e.* 2

∴ the check-figure is 2.

(2) Required the check-figure of £57,312.

From 312 take 57 = 255

$2\times4=8$

$55-8=47$ *i.e.* 8

∴ the check-figure is 8

(3) Required the check-figure of £365,234

From 365 take 234 leaves 131

As the check for 1000 is − 1

∴ the check of 131,000 is -131 or -1

(throwing out 130 the multiple of 13)

∴ the check-figure is 12.

SPECIAL DEVICE SUGGESTED FOR QUICKLY ARRIVING AT THE CHECK-FIGURE WITH THIS BASE-NUMBER WITH THE VIEW OF MORE SPEEDILY LOCATING ERRORS WHICH MAY BE CLASSIFIED UNDER THE SCHEDULES B AND D.

Amend the formula shown under Negative Checks by adding 3 to the check-figure of each penny so that the check-figure of one penny will be the same as one pound, *e.g.*

AMENDED FORMULA (13a SYSTEM).

Check-figure	for each	£1	... 1
,,	,,	1/-	... 2
,,	,,	1d.	... 1

Example:—

Add the following amounts, viz:

£	s.	d.	C.F.	MENTAL PROCESS.
163	17	4	6	163+4+(17×2)=201 $\frac{20}{4}$=5+1= 6
29	6	5	7	29+5+(6×2)= 46 $\frac{4}{4}$ =1+6= 7
18	9	4	1	18+4+(9×2)= 40 $\frac{4}{4}$ =1
11	7	9	8	11+9+(7×2)= 34 *i.e.* 8
301	2	6	12	301+6+(2×2)=311 3×9=27+11=38 *i.e.* 12
812	13	7	0	812+7+0 =819 8×9=72+19=91 *i.e.* 0
1336	16	11	8	
			35	

To reconcile the check-figure of the total with the check-figure column proceed as follows:—

(1) Use the original formula

Ignore £1300 and all multiples of 13 as indicated in the process used above for £812 13s. 7d. The total immediately becomes £36 16s. 11d.

$(16-11)\times 2=10+36=46$ *i.e.* 7

(2) Note the 35 under the pence column. This indicates the number of pence to which 3 has been added when ascertaining the check-figure by the amended formula.

$35\times 3=105$ *i.e.* 1

$\therefore$ the effect produced on the total by using a process which alters the relative values of pounds, shillings and pence is + 1.

(3) Add the results obtained from processes (1) and (2)

$7+1=8$

The figure 8 agrees with the check of the total of the check-figure column, and consequently the addition may be considered to have been accurately performed.

This amended formula does not permit the calculations to be done as quickly as the amended formula suggested for base-number 7, but it is

much more reliable, as all transpositions of shillings and pence will be detected.

If the methods adopted for discovering errors under the various schedules shown in Part IV. are utilised for testing the accuracy of this amended formula, which retains the positive style throughout the calculation, the following results will be apparent, viz:—

The errors under Class 2, Schedules B and D will be very easily remembered, as every transposition which may be classified under these Schedules (including the List of Most Probable Errors), and which will not be detected by using this formula, is restricted to amounts showing the same figures in the shillings and pence columns under Schedule B and the same figures in the pounds and shillings columns under Schedule D, *e.g.*

Posting	£0	1	1	as	£1	1	0	and	*vice versa*
„	0	2	2	as	2	2	0		„
„	1	3	3	as	3	3	1		„

or a difference of 13, *e.g.*

Posting	£0	14	1	as	£14	1	0	and	*vice versa*
„	0	15	2	as	15	2	0		„

Such differences would be more easily detected than those created by the transpositions shown in the List of Errors given under Base-number 13 in Part IV. (Schedules B and D).

Unless the bookkeeper is thoroughly convinced, however, that he would never transpose pounds and pence, any formula which shows the same check-figure for each pound and each penny should be discarded without the slightest hesitation. There are competent bookkeepers, nevertheless, who may be using the base-number 13, and they may have become so accustomed to throwing out the multiples of 13 that this simple formula may be considered more favourably than changing entirely to the base-number 19, more especially if they feel confident that such transpositions of the extreme columns, pounds and pence, have rarely, if ever, occurred in their experience.

Base-number 17.

Formula :—

Check-figure	for each	£1	... 3
„	„	1/-	... 1
„	„	1d.	... 10

Formula arrived at as follows :—

£1 = 2400 tenths of 1d. 2400 ÷ 17 = 141 and leaves 3
1/- = 120 „ „ 120 ÷ 17 = 7 „ 1
1d. = 10 „ „ 10 ÷ 17 = 0 „ 10

To ascertain the check-figure of any amount:—

1.—Positive Checks.

Multiply the pounds by 3 and add the product to the shillings and 10 times the pence, *e.g.*

Required the check-figure of £12 6s. 8d.

$$12\times3 = 36+6+80.$$
$$= 36+86.$$
$$= 122 \quad i.e.\ 3.$$

∴ the check-figure is 3.

2.—Negative Checks.

Maintain the positive style until the total is ascertained; and either deduct the total from the next higher multiple of 17 or deduct the check-figure of the total from base-number 17, *e.g.*

Required the negative check of £17 8s. 5d.

$$17\times3 = 51+8+50.$$
$$= 109.$$

(a) Next higher multiple is 119.
∴ the check is $119-109=10$.

(b) The check-figure of 109 is 7.
∴ the check is $17-7=10$.

PARTICULAR DEVICES SUGGESTED FOR SPEEDILY ARRIVING AT THE CHECK-FIGURE.

(1) When there is only one figure in the shillings column, as in the above examples,

place the pence immediately before the shillings thus:—

6/8 becomes 86
8/5 becomes 58

(2) The check-figure of any *even* number of pence is half as much again as that figure, and is a *positive* check.

(3) To ascertain the check-figures of the *odd* numbers of pence it is preferable to convert the positive checks into negative checks.

Write down the following multiples of 17, viz:
1/5 4/3 7/1 9/11 12/9 15/7

The *negative* check of each of the pence is the number in the shillings column immediately preceding the pence. This check must be deducted from the check-figure of the pounds and shillings columns, *e.g.*

Required the check-figure of £23 4s. 5d.

$23 \times 3 = 69 + 4 = 73$

Deduct check-figure of 5d. = 1

72 *i.e.* 4

The second and third devices are better than the first, as the final result of most calculations will be under 100 and a knowledge of the multiples of 17 up to 102 will be of assistance in speedily recording the check-figure.

(4) When the above multiples are thoroughly learned, it may often be found convenient to adopt the following method of calculation, viz:—

Required the check-figure of £28 15 9

(a) Deduct the multiple 0 15 7

£28 0 2

(b) $28 \times 3 = 84 + 3^{*} = 87$

Deduct the multiple 85

∴ the check-figure is ... 2

* $2+(\frac{1}{2}$ of $2)=3$

(5) Note the hints given in Part I., pages 9 and 10, for simplifying the calculations of three and four figures in the pounds column, and consider the further adaptability of the methods explained there, when the check-figure of the pounds column is greater than 1, *e.g.*

The check-figure of each hundred is 15 or -2.
„ „ „ thousand is 14 or -3.

As the check-figure of each pound is 3, the ultimate check-figure for each hundred will ∴ be -6, and the ultimate check-figure for each thousand will ∴ be -9.

Utilize the knowledge acquired from the study of fractions, *e.g.*

$-\frac{1}{3} = -6.$

$-\frac{1}{2} = -9.$

Consequently, if the hundreds are divisible by 3 and the thousands are divisible by 2, the calculations may be reduced as follow:—

(a) Required the check-figure of £4523.

$23 \times 3 = 69$

Deduct $45 \div 3 = 15$

54 *i.e.* 3

(b) Required the check-figure of £18223.

$223 = 23 - 4 = 19$

$19 \times 3 = 57$

Deduct $\frac{1}{2}$ of $18 = 9$

48 *i.e.* 14

(6) For amounts under £100 note that the check for each unit is 3 and as

$\frac{1}{6} = 3$

if the pounds are divisible by 6 the calculations may be reduced as follow:—

Required the check-figure of £84 3s. 4d.

$84 \div 6 = 14$

Add the shillings $= 3$

„ $1\frac{1}{2}$ times pence $= 6$

23 *i.e.* 6

∴ the check-figure is 6.

Base-number 19.

Formula:

Check-figure	for each	£1	...	1
„	„	1/-	...	1
„	„	1d.	...	8 or −11

Formula arrived at as follows:—

£1 = $\frac{1920}{8}$ of 1d. : 1920÷19 = 101 and leaves 1
1/- = $\frac{96}{8}$ „ : 96÷19 = 5 „ 1
1d. = $\frac{8}{8}$ „ : 8÷19 = 0 „ 8

Numerous examples are given in Part I. to show how speedily the check-figures of amounts under £1,000 may be arrived at by using the above formula, and adopting the various suggestions for reducing the mental calculations.

For amounts under £20 note that the multiples of 19 in the pounds and shillings columns may be quickly thrown out, *e.g.*

£ 6	13	0	6+13=19
12	7	0	12+ 7=19
18	1	0	18+ 1=19
19	0	0	19+ 0=19

TO ASCERTAIN THE CHECK-FIGURES OF LARGE AMOUNTS.

Place the check-figure for each unit, ten, hundred, etc., as shown on page 8 over any large number of pounds, *e.g.*

3	6	12	5	10	1
£5	6	3,	2	4	1

Refer to the check-figures of Fractions shown on page 39 and note the following:—

$\frac{1}{2} = 10$, $\frac{1}{4} = 5$, $\frac{1}{8} = 12$, $\frac{1}{16} = 6$, $\frac{1}{13} = 3$

If the number of thousands is divided by 8 the check-figure will be the same as multiplying the thousands by 12, *e.g.*

(a) $563 \div 8 = 70\frac{3}{8}$
$= 70 + 36$
$= 106$ *i.e.* 11

(b) $563 \times 12 = 6756$
Divide 6756 by 19 : leaves 11

Similarly, the check-figure of hundreds may be ascertained by dividing the number of hundreds by 4. The check-figure of tens of thousands may be ascertained by dividing by 16; or dividing by 4, in the first instance, and considering the quotient as equivalent to so many hundreds; then adding the quotient to the number of hundreds, and converting the whole into an equivalent number of units by again dividing by 4, *e.g.*

Required the check-figure of £563241

$56 \div 4 = 14$
$32 + 14 = 46$
$46 \div 4 = 11\frac{1}{2}$
$= 21$ (as $\frac{1}{2} = 10$)
$41 + 21 = 62$ *i.e.* 5

The check-figure of £563241 is 5.

This check-figure may be reconciled with the process for thousands of pounds as follows:—

The check-figure	of	£563000	is	11	
„	„	„ 241	is	13	
∴ „	„	„ £563241	is	24	*i.e.* 5.

As dividing by 8 leaves too many remainders, it is preferable to adopt the latter method unless the thousands are exactly divisible by 8. The check-figures of the following fractions should be learned, viz.:—

The check-figure	of	$\frac{1}{4}$ =	5
„	„	$\frac{1}{2}$ =	10
„	„	$\frac{3}{4}$ =	15 or −4

The check-figures of the fractions should be added to the quotient before adding the result to the next set of figures.

ADDITIONS OF DOUBLE COLUMNS.

Both columns may be added up at the same time, and the multiples of 19 thrown out whenever an even number of tens appears, *e.g.*, 87 may be considered as 11, or further down the page 123 may be converted into 9.

PART IV.

Schedules A to P, indicating the number of errors under Classes 1, 2, 3, 4, 5, and 6, and "Other Errors," which will not be detected by adopting the respective base-numbers 7, 14, 13, 17, and 19.—Summary of errors in Schedules A to N under each base-number.

Schedule A.

Transposition of Shillings and Pence only.

The base-number 7 is the only base-number which will not detect every transposition of shillings and pence. (See Part I, page 17).

Schedule B.

Transposition of Pounds, Shillings and Pence
e.g. Posting £1 2s. 3d. as £2 3s. 1d.

There are over 300 errors which will not be detected by using base-number 7.

Instead of showing the actual amounts which, if transposed in the same manner as shown above, viz :—

Posting Pounds as pence
„ Shillings as pounds
„ Pence as shillings

will have the same check-figures as the original amounts appearing in the Primary Records, it has been considered advisable to indicate the principle

adopted in arriving at the errors shown under each base-number in Schedule B.

Base-number 7.

The check-figure for each £1 is 1
„ „ „ 1/- is 6
„ „ „ 1d. is 4

If £1 is posted as 1d.
the check-figure will vary by +3

If 1/- is posted as £1
the check-figure will vary by −5

If 1d. is posted as 1/-
the check-figure will vary by +2

The greatest number of pounds which can be posted as pence is 11.

The greatest number of shillings which can be posted as pounds is 19.

The greatest number of pence which can be posted as shillings is 11.

Prepare a Schedule showing:—

On the top.

Every figure which may appear in pounds column indicating *underneath* the variation in the check-figure by posting each pound as pence.

On the left side.

In 1st column. Every figure which may appear in the shillings column.

In 2nd column. The variation in the check-figure by posting each number of shillings in pounds column.

In the margin, or underneath.

In 1st column. Every figure which may appear in the pence column.

In 2nd column. The variation in the check-figure by posting each number of pence in the shillings column.

Re-arrange check-figures of pence in numerical order.

As the check-figure for pence is positive, make the check-figures for pounds and shillings negative, *e.g.*

The variation in the check-figure for each pound posted as one penny is $+3$ or -4

The variation in the check-figure for each shilling posted as one pound is -5

$\therefore$ the total variation in the check-figure of £1 1/- is -2

Any combination of pounds and shillings, which produces the same variation in the check-figure appearing opposite any number in the pence column, will have the same check-figure when transposed if such pounds and shillings appear in the original amount along with the number of

Schedule used to discover errors in 1st System—Base-number 7—under Class 2 (Schedule B).

Shillings.			Pounds.										
			0	1	2	3	4	5	6	7	8	9	10	11
No of Shillings.		Check varies by	Variation in Check-figure for each £—4 (all negative checks).											
			0	4	1	5	2	6	3	0	4	1	5	2
0	Variation in Check-figure for each shilling—5 (all negative checks).	0	0	4	1	5	2	6	3	0	4	1	5	2
1		5	5	2	6	3	0	4	1	5	2	6	3	0
2		3	3	0	4	1	5	2	6	3	0	4	1	5
3		1	1	5	2	6	3	0	4	1	5	2	6	3
4		6	6	3	0	4	1	5	2	6	3	0	4	1
5		4	4	1	5	2	6	3	0	4	1	5	2	6
6		2	2	6	3	0	4	1	5	2	6	3	0	4
7		0	0	4	1	5	2	6	3	0	4	1	5	2
8		5	5	2	6	3	0	4	1	5	2	6	3	0
9		3	3	0	4	1	5	2	6	3	0	4	1	5
10		1	1	5	2	6	3	0	4	1	5	2	6	3
11		6	6	3	0	4	1	5	2	6	3	0	4	1
12		4	4	1	5	2	6	3	0	4	1	5	2	6
13		2	2	6	3	0	4	1	5	2	6	3	0	4
14		0	0	4	1	5	2	6	3	0	4	1	5	2
15		5	5	2	6	3	0	4	1	5	2	6	3	0
16		3	3	0	4	1	5	2	6	3	0	4	1	5
17		1	1	5	2	6	3	0	4	1	5	2	6	3
18		6	6	3	0	4	1	5	2	6	3	0	4	1
19		4	4	1	5	2	6	3	0	4	1	5	2	6

Pence.

Variation in Check-figure for each Penny + 2.

No. of Pence.	Check varies by
0	0
1	2
2	4
3	6
4	1
5	3
6	5
7	0
8	2
9	4
10	6
11	1

Re-arrangement of check-figures in numerical order.

Check Figure.	No. of Pence,
0	0 & 7
1	4 & 11
2	1 & 8
3	5
4	2 & 9
5	6
6	3 & 10

pence shown opposite the same variation in the check-figure, *e.g.*

£6 11s. 8d.

Under the £6 column on the 11/- line the figure 2 appears. This represents −2 and consequently £6 11s. 8d. (the variation in the check-figure after transposition of 8 pence as 8 shillings being +2) will have the same check-figure as £11 8s. 6d.

Schedules for each base-number may be prepared as follows:—

Base-number 14.

	£	s.	d.
Formula	2	−2	1
or	2	12	1

Check for each pound varies by − 1
„ shilling „ −10
„ penny „ +11

Base-number 13.

	£	s.	d.
Formula	−1	−2	2
or	12	11	2

Check for each pound varies by + 3
„ shilling „ + 1
„ penny „ − 4

Base-number 17

	£	s.	d.
Formula	3	1	10

All positive checks.

Check for each pound varies by + 7
„ shilling „ + 2
„ penny „ − 9

Base-number 19a. £ s. d.

Formula 1 – 1 – 11

or 1 18 8

Check for each pound varies by +7

„ shilling „ +2

„ penny „ −9

Base-number 19. £ s. d.

Original Formula 1 1 8

All positive checks.

Check for each pound varies by +7

„ shilling *does not vary*

„ penny varies by −7

As the variation in the check for each pound, in this case, cancels a similar variation in the check for the same number in the pence column, every transposition under Schedule B will be detected.

The errors under Schedule B which will not be detected by adopting the respective base-numbers 14, 13, 17, and 19a are enumerated on the following pages. Those discovered by the process indicated on page 90 under £0 column are shown in a separate Schedule as "Most Probable Errors."

SCHEDULE B

MOST PROBABLE ERRORS.

Posting Shillings and Pence as Pounds and Shillings.

No. of Errors.	Base Numbers. 7		14		13		17		19a	
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
1	1	6	1	6	1	10	1	4	2	11
2	2	5	3	4	2	7	2	8	3	7
3	3	4	4	10	3	4	5	3	4	3
4	3	11	5	2	4	1	6	7	7	10
5	4	3	6	8	5	11	7	11	8	6
6	4	10	7	0	6	8	9	2	9	2
7	5	2	8	6	7	5	10	6	12	9
8	5	9	10	4	8	2	11	10	13	5
9	6	1	11	10	10	9	13	1	14	1
10	6	8	12	2	11	6	14	5	17	8
11	7	0	13	8	12	3	15	9	18	4
12	7	7	14	0	13	0	17	0	19	0
13	8	6	15	6	14	10	18	4		
14	9	5	17	4	15	7	19	8		
15	10	4	18	10	16	4				
16	10	11	19	2	17	1				
17	11	3	...	...	18	11				
18	11	10	...	...	19	8				
19	12	2								

No. of Errors.	Base Numbers. 7	14	13	17	19a
	s. d.				
20 ..	12 9				
21 ...	13 1				
22 ...	13 8				
23 ...	14 0				
24 ...	14 7				
25 ...	15 6				
26 ...	16 5				
27 ...	17 4				
28 ...	17 11				
29 ...	18 3				
30 ...	18 10				
31 ...	19 2				
32 ...	19 9				

[Note.—*The probabilities of errors in this section not being detected are increased as shown under Class 6 (page 36) to the extent of 9 times the number of errors shown under each base-number.*]

The errors shown under base-number 19A are those which will not be detected by adopting the formula given on page 24.

Where shillings only appear, the check-figure is 0, and if the letter A is used for pounds, and B for shillings, in the check-figure columns, such transpositions may easily be detected.

SCHEDULE B.

Other Errors, *e.g.* Posting £1 2s. 3d. as £2 3s. 1d.

BASE-NUMBERS.

No.	14 £	s.	d.	13 £	s.	d.	17 £	s.	d.	19a £	s.	d.
1	1	0	9	1	0	4	1	2	5	1	0	5
2	1	2	7	1	2	11	1	3	9	1	4	8
3	1	4	5	1	3	8	1	5	0	1	5	4
4	1	5	11	1	4	5	1	6	4	1	6	0
5	1	6	3	1	5	2	1	7	8	1	8	11
6	1	7	9	1	7	9	1	10	3	1	9	7
7	1	9	7	1	8	6	1	11	7	1	10	3
8	1	11	5	1	9	3	1	12	11	1	13	10
9	1	12	11	1	10	0	1	14	2	1	14	6
10	1	13	3	1	11	10	1	15	6	1	15	2
11	1	14	9	1	12	7	1	16	10	1	18	9
12	1	16	7	1	13	4	1	19	5	1	19	5
13	1	18	5	1	15	11	2	0	11	2	0	10
14	1	19	11	1	16	8	2	3	6	2	1	6
15	2	0	4	1	17	5	2	4	10	2	5	9
16	2	1	10	1	18	2	2	6	1	2	6	5
17	2	3	8	2	0	8	2	7	5	2	7	1
18	2	4	0	2	1	5	2	8	9	2	10	8
19	2	5	6	2	4	9	2	10	0	2	11	4
20	2	7	4	2	5	6	2	11	4	2	12	0
21	2	8	10	2	6	3	2	12	8	2	14	11
22	2	10	8	2	7	0	2	15	3	2	15	7
23	2	11	0	2	8	10	2	16	7	2	16	3

BASE-NUMBERS.

No.	14 £	s.	d.	13 £	s.	d.	17 £	s.	d.	19a £	s.	d.
24	2	12	6	2	9	7	2	17	11	2	19	10
25	2	14	4	2	10	4	3	0	8	3	1	11
26	2	15	10	2	11	1	3	4	7	3	2	7
27	2	17	8	2	12	11	3	5	11	3	6	10
28	2	18	0	2	13	8	3	7	2	3	7	6
29	2	19	6	2	14	5	3	8	6	3	8	2
30	3	1	5	2	17	9	3	9	10	3	11	9
31	3	2	11	2	18	6	3	11	1	3	12	5
32	3	4	9	2	19	3	3	12	5	3	13	1
33	3	5	1	3	1	9	3	13	9	3	16	8
34	3	6	7	3	2	6	3	15	0	3	17	4
35	3	8	5	3	4	0	3	16	4	3	18	0
36	3	9	11	3	5	10	3	17	8	4	0	1
37	3	11	9	3	6	7	4	0	5	4	3	8
38	3	12	1	3	7	4	4	1	9	4	5	0
39	3	13	7	3	8	1	4	3	0	4	7	11
40	3	15	5	3	9	11	4	5	8	4	8	7
41	3	16	11	3	10	8	4	8	3	4	9	3
42	3	18	9	3	11	5	4	9	7	4	12	10
43	3	19	1	3	12	2	4	10	11	4	13	6
44	4	0	8	3	14	9	4	12	2	4	14	2
45	4	1	0	3	15	6	4	13	6	4	17	9
46	4	2	6	3	17	0	4	14	10	4	18	5
47	4	5	10	3	18	10	4	16	1	4	19	1
48	4	6	2	3	19	7	4	17	5	5	0	6
49	4	7	8	4	0	3	4	18	9	5	1	2
50	4	8	0	4	1	0	5	0	2	5	4	9

No.	14 £	s.	d.	13 £	s.	d.	17 £	s.	d.	19a £	s.	d.
51	4	9	6	4	2	10	5	1	6	5	6	1
52	4	12	10	4	3	7	5	2	10	5	9	8
53	4	13	2	4	5	1	5	4	1	5	10	4
54	4	14	8	4	6	11	5	6	9	5	11	0
55	4	15	0	4	7	8	5	8	0	5	13	11
56	4	16	6	4	8	5	5	9	4	5	14	7
57	4	19	10	4	9	2	5	10	8	5	15	3
58	5	0	3	4	11	9	5	13	3	5	18	10
59	5	1	9	4	12	6	5	14	7	5	19	6
60	5	2	1	4	13	3	5	15	11	6	0	11
61	5	3	7	4	14	0	5	17	2	6	1	7
62	5	6	11	4	15	10	5	18	6	6	2	3
63	5	7	3	4	16	7	5	19	10	6	5	10
64	5	8	9	4	18	1	6	1	3	6	7	2
65	5	9	1	4	19	11	6	2	7	6	10	9
66	5	10	7	5	0	7	6	3	11	6	11	5
67	5	13	11	5	1	4	6	5	2	6	12	1
68	5	14	3	5	2	1	6	7	10	6	15	8
69	5	15	9	5	3	11	6	9	1	6	16	4
70	5	16	1	5	4	8	6	10	5	6	17	0
71	5	17	7	5	6	2	6	11	9	6	19	11
72	6	1	4	5	8	9	6	13	0	7	2	8
73	6	2	10	5	9	6	6	14	4	7	3	4
74	6	3	2	5	10	3	6	15	8	7	4	0
75	6	4	8	5	11	0	6	18	3	7	6	11
76	6	5	0	5	12	10	6	19	7	7	8	3
77	6	8	4	5	13	7	7	1	0	7	11	10

BASE-NUMBERS.

	14			13			17			19a		
No.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
78	6	9	10	5	14	4	7	2	4	7	12	6
79	6	10	2	5	15	1	7	3	8	7	13	2
80	6	11	8	5	16	11	7	6	3	7	16	9
81	6	12	0	5	17	8	7	8	11	7	17	5
82	6	15	4	5	19	2	7	10	2	7	18	1
83	6	16	10	6	0	11	7	11	6	8	0	2
84	6	17	2	6	1	8	7	12	10	8	3	9
85	6	18	8	6	2	5	7	14	1	8	4	5
86	6	19	0	6	3	2	7	15	5	8	5	1
87	7	2	5	6	5	9	7	16	9	8	9	4
88	7	3	11	6	7	3	7	18	0	8	10	0
89	7	4	3	6	8	0	7	19	4	8	12	11
90	7	5	9	6	9	10	8	0	10	8	13	7
91	7	6	1	6	10	7	8	2	1	8	14	3
92	7	9	5	6	11	4	8	3	5	8	17	10
93	7	10	11	6	12	1	8	4	9	8	18	6
94	7	11	3	6	13	11	8	6	0	8	19	2
95	7	12	9	6	14	8	8	7	4	9	0	7
96	7	13	1	6	15	5	8	11	3	9	1	3
97	7	16	5	6	16	2	8	12	7	9	4	10
98	7	17	11	6	18	9	8	13	11	9	5	6
99	7	18	3	7	0	2	8	15	2	9	6	2
100	7	19	9	7	2	9	8	16	6	9	10	5
101	8	0	2	7	3	6	8	17	10	9	11	1
102	8	2	0	7	4	3	8	19	1	9	14	8
103	8	3	6	7	5	0	9	0	7	9	15	4
104	8	5	4	7	6	10	9	1	11	9	16	0

BASE-NUMBERS.

	14			13			17			19a		
No.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
105	8	6	10	7	8	4	9	3	2	9	18	11
106	8	7	2	7	9	1	9	4	6	9	19	7
107	8	9	0	7	10	11	9	5	10	10	1	8
108	8	10	6	7	11	8	9	7	1	10	2	4
109	8	12	4	7	12	5	9	8	5	10	3	0
110	8	13	10	7	13	2	9	11	0	10	5	11
111	8	14	2	7	15	9	9	12	4	10	6	7
112	8	16	0	7	16	6	9	13	8	10	7	3
113	8	17	6	7	17	3	9	16	3	10	11	6
114	8	19	4	7	18	0	9	17	7	10	12	2
115	9	0	11	7	19	10	9	18	11	10	15	9
116	9	1	3	8	0	6	10	0	4	10	16	5
117	9	3	1	8	1	3	10	1	8	10	17	1
118	9	4	7	8	2	0	10	4	3	11	2	9
119	9	6	5	8	3	10	10	5	7	11	3	5
120	9	7	11	8	4	7	10	6	11	11	4	1
121	9	8	3	8	5	4	10	8	2	11	7	8
122	9	10	1	8	6	1	10	9	6	11	8	4
123	9	11	7	8	7	11	10	12	1	11	9	0
124	9	13	5	8	9	5	10	13	5	11	12	7
125	9	14	11	8	10	2	10	14	9	11	13	3
126	9	15	3	8	12	9	10	16	0	11	16	10
127	9	17	1	8	13	6	10	17	4	11	17	6
128	9	18	7	8	14	3	10	18	8	11	18	2
129	10	0	6	8	15	0	11	0	1		—	
130	10	2	4	8	16	10	11	1	5		—	
131	10	4	2	8	17	7	11	2	9		—	

BASE-NUMBERS.

No.	14 £	s.	d.	13 £	s.	d.	17 £	s.	d.	19a £	s.	d.
132	10	5	8	8	18	4	11	4	0	—		
133	10	6	0	8	19	1	11	5	4	—		
134	10	7	6	9	0	10	11	6	8	—		
135	10	9	4	9	1	7	11	9	3	—		
136	10	11	2	9	2	4	11	10	7	—		
137	10	12	8	9	3	1	11	13	2	—		
138	10	13	0	9	4	11	11	14	6	—		
139	10	14	6	9	5	8	11	15	10	—		
140	10	16	4	9	6	5	11	17	1	—		
141	10	18	2	9	7	2	11	18	5	—		
142	10	19	8	9	10	6	11	19	9	—		
143	11	0	1	9	11	3	—			—		
144	11	1	7	9	12	0	—			—		
145	11	3	5	9	13	10	—			—		
146	11	5	3	9	14	7	—			—		
147	11	6	9	9	15	4	—			—		
148	11	7	1	9	16	1	—			—		
149	11	8	7	9	17	11	—			—		
150	11	10	5	9	18	8	—			—		
151	11	12	3	9	19	5	—			—		
152	11	13	9	10	0	1	—			—		
153	11	14	1	10	1	11	—			—		
154	11	15	7	10	2	8	—			—		
155	11	17	5	10	3	5	—			—		
156	11	19	3	10	4	2	—			—		
157		—		10	6	9	—			—		
158		—		10	7	6	—			—		

BASE-NUMBERS.

	14			13			17			19a		
No.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
159 ...	—			... 10	8	3 ...	—		...	—		
160 ...	—			... 10	9	0 ...	—		...	—		
161 ...	—			... 10	11	7 ...	—		...	—		
162 ...	—			... 10	12	4 ...	—		...	—		
163 ...	—			... 10	13	1 ...	—		...	—		
164 ...	—			... 10	14	11 ...	—		...	—		
165 ...	—			... 10	15	8 ...	—		...	—		
166 ...	—			... 10	16	5 ...	—		...	—		
167 ...	—			... 10	17	2 ...	—		...	—		
168 ...	—			... 10	19	9 ...	—		..	—		
169 ...	—			... 11	0	5 ...	—		...	—		
170 ...	—			... 11	1	2 ...	—		...	—		
171 ...	—			... 11	3	9 ...	—		...	—		
172 ...	—			... 11	4	6 ...	—		...	—		
173 ...	—			... 11	5	3 ...	—		...	—		
174 ...	—			... 11	6	0 ...	—		...	—		
175 ...	—			... 11	7	10 ...	—		..	—		
176 ...	—			... 11	8	7 ...	—		...	—		
177 ...	—			... 11	9	4 ...	—		...	—		
178 ...	—			... 11	10	1 ...	—		...	—		
179 ...	—			... 11	12	8 ...	—		...	—		
180 ...	—			... 11	13	5 ...	—		...	—		
181 ...	—			... 11	14	2 ...	—		...	—		
182 ..	—			... 11	16	9 ...	—		...	—		
183 ...	—			... 11	17	6 ...	—		...	—		
184 ...	—			... 11	18	3 ...	—		...	—		
185 ...	—			... 11	19	0 ...	—		...	—		

Schedule C.

Transposition of Pounds and Shillings only.

The errors under this Schedule which will not be detected by adopting the respective base-numbers are as follow:—

Base-number 7.

	£	s.	d.		£	s.	d.	
Posting	1	8	0	as	8	1	0	and *vice versa.*
„	1	15	0	„	15	1	0	„
„	2	9	0	„	9	2	0	„
„	2	16	0	„	16	2	0	„
„	3	10	0	„	10	3	0	„
„	3	17	0	„	17	3	0	„
„	4	11	0	„	11	4	0	„
„	4	18	0	„	18	4	0	„
„	5	12	0	„	12	5	0	„
„	5	19	0	„	19	5	0	„
„	6	13	0	„	13	6	0	„
„	7	14	0	„	14	7	0	„
„	8	15	0	„	15	8	0	„
„	9	16	0	„	16	9	0	„
„	10	17	0	„	17	10	0	„
„	11	18	0	„	18	11	0	„
„	12	19	0	„	19	12	0	„

Base-number 14.

	£	s.	d.		£	s.	d.	
Posting	1	15	0	as	15	1	0	and *vice versa.*
„	2	16	0	„	16	2	0	„
„	3	17	0	„	17	3	0	„
„	4	18	0	„	18	4	0	„
„	5	19	0	„	19	5	0	„

Base-number 13.

	£	s.	d.		£	s.	d.	
Posting	1	14	0	as	14	1	0	and *vice versa.*
„	2	15	0	„	15	2	0	„
„	3	16	0	„	16	3	0	„
„	4	17	0	„	17	4	0	„
„	5	18	0	„	18	5	0	„
„	6	19	0	„	19	6	0	„

Base-number 17.

	£	s.	d.		£	s.	d.	
Posting	1	18	0	as	18	1	0	and *vice versa.*
„	2	19	0	„	19	2	0	„

Base-number 19.

Transposing any figures in the Pounds and Shillings columns from 1 to 18 inclusive, unless the suggestions in Part I, page 21, are adopted. If the amended formula for base-number 19 is used, *i.e.*,

Base-number 19a.

the only errors which will not be detected by adopting this amended formula are:—

Posting 19s. as £19 and *vice versa*,

but these and similar errors for the other base-numbers, *e.g.*, 13s. posted as £13, are already enumerated under Schedule B as "Most Probable Errors," and a suggestion is made at the foot of that Schedule for facilitating the detection of such errors.

If there is the slightest tendency to post £117 13s. as £113 17s., the first suggestion in Part I for eliminating errors of this nature should be amended so as to read on the fourth line "when the *units* in the pounds column exceed the *units* in the shillings column."

Schedule D.

Transposition of Pounds, Shillings and Pence, *e.g.*, Posting £1 2s. 3d. as £3 1s. 2d.

A Schedule similar to that used for discovering errors under Schedule B is shown on pages 106 and 107, the base-number 13 being used, on this occasion, to illustrate the method adopted. If a list is prepared, and subdivided, as shown under Schedule B, it will be found that it is only necessary to add "and *vice versa*," to the amounts appearing on pages 94 to 102. The number of errors therefore which will not be detected under this Schedule by adopting the respective base-numbers is as follows:—

Base-number	7	over 300.
„	14	172.
„	13	203.
„	17	156.
„	19a	140.

If £22 3s. od. is posted as £20 2s. 3d., and also similar amounts, the number of errors which will not be detected is greatly increased, but

Schedule used to discover errors in 3rd System—Base-number 13—under Class 2 (Schedule D).

Shillings.			Pence.											
			0	1	2	3	4	5	6	7	8	9	10	11
No. of Shillings.		Check varies by	Variation in Check-figure for each Penny + 10.											
			0	10	7	4	1	11	8	5	2	12	9	6
0	Variation in Check-figure for each Shilling + 4	0	0	10	7	4	1	11	8	5	2	12	9	6
1		4	4	1	11	8	5	2	12	9	6	3	0	10
2		8	8	5	2	12	9	6	3	0	10	7	4	1
3		12	12	9	6	3	0	10	7	4	1	11	8	5
4		3	3	0	10	7	4	1	11	8	5	2	12	9
5		7	7	4	1	11	8	5	2	12	9	6	3	0
6		11	11	8	5	2	12	9	6	3	0	10	7	4
7		2	2	12	9	6	3	0	10	7	4	1	11	8
8		6	6	3	0	10	7	4	1	11	8	5	2	12
9		10	10	7	4	1	11	8	5	2	12	9	6	3
10		1	1	11	8	5	2	12	9	6	3	0	10	7
11		5	5	2	12	9	6	3	0	10	7	4	1	11

Pounds.

Variation in Check-figure for each £ − 1. (all negative checks).

No. of Pounds.	Check varies by
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19

Re-arrangement of check-figures in numerical order.

Check Figure.	No. of Pounds.
0	0 & 13
1	1 & 14
2	2 & 15
3	3 & 16
4	4 & 17
5	5 & 18
6	6 & 19
7	7
8	8
9	9
10	10
11	11
12	12

as the former amount is less likely to be read out as "twenty-two three," as in the latter case, these possible errors are not included in the numbers stated above.

SCHEDULE E.

Transposition of Pounds and Pence only.

The errors under this Schedule which will not be detected by adopting base-number 7 are indicated as follow:—

Base-number 7.

	£	s.	d.		£	s.	d.	
Posting	0	0	7	as	7	0	0	and *vice versa.*
„	1	0	8	„	8	0	1	„
„	2	0	9	„	9	0	2	„
„	3	0	10	„	10	0	3	„
„	4	0	11	„	11	0	4	„

All the other base-numbers will detect transpositions of this nature, as the difference between the figures transposed must be respectively 14, 13, 17, and 19.

SCHEDULE F.

Transposition of Tens and Units,
e.g., Posting £123 as £132.

The base-number 7 is the only base-number which will not detect every transposition. (See page 35).

Schedule G.

The errors which will not be detected by the respective base-numbers 14, 13, 17, and 19 are enumerated on pages 112 and 113. The method adopted in order to discover those errors is explained on page 111.

Schedule H.

Transposition of Hundreds and Tens,

e.g., Posting £123 as £213.

The base-numbers 7 and 14 are the only base-numbers which will not detect every transposition. (See page 35).

Schedule I.

The errors which will not be detected by the respective base-numbers 14, 13, 17, and 19 are enumerated on pages 116 and 117. The method adopted in order to discover those errors is explained on page 115.

Schedule K.

Transposition of Hundreds and Units,

e.g., Posting £123 as £321.

The base-number 7 is the only base-number which will not detect every transposition. (See page 35).

SCHEDULE G.

Schedule used for discovering Transpositions of Three Figures in Pounds Column which will not be detected by the respective base-numbers, *e.g.*

Posting £123 as £231.

(1) TENS AND UNITS.

Original Figures for Tens and Units.	Difference created by transposition.	Variation in Check-figure (all negative checks). Base-numbers				
		7	14	13	17	19
10 ...	90 ...	6	6	12	5	14
11 ...	99 ...	1	1	8	14	4
12 ...	108 ...	3	10	4	6	13
13 ...	117 ...	5	5	0	15	3
14 ...	126 ...	0	0	9	7	12
15 ..	135 ...	2	9	5	16	2
16 ...	144 ...	4	4	1	8	11
17 ...	153 ...	6	13	10	0	1
18 ...	162 ...	1	8	6	9	10
19 ..	171 ...	3	3	2	1	0
20 ...	180 ...	5	12	11	10	9
21 ...	189 ...	0	7	7	2	18
22 ...	198 ...	2	2	3	11	8
23 ...	207 ...	4	11	12	3	17
24 ...	216 ...	6	6	8	12	7
25 ...	225 ...	1	1	4	4	16
26 ...	234 ...	3	10	0	13	6
27 ...	243 ...	5	5	9	5	15
28 ...	252 ...	0	0	5	14	5

(2) HUNDREDS.

Original Figure for Hundreds.	Difference created by transposition.	Variation in Check-figure (all positive checks). Base-numbers				
		7	14	13	17	19
1 ...	99 ..	1	1	8	14	4
2 ...	198 ...	2	2	3	11	8
3 ...	297 ...	3	3	11	8	12
4 ...	396 ..	4	4	6	5	16
5 ...	495 ...	5	5	1	2	1
6 ...	594 ...	6	6	9	16	5
7 ...	693 ..	0	7	4	13	9
8 ...	792 ...	1	8	12	10	13
9 ...	891 ..	2	9	7	7	17

Method explained :—

(1) Commence with the Hundreds :

Opposite the original figure for Hundreds 1, under the base-number 13, appears the figure 8.

(2) Look for the same variation in the Tens and Units section.

Opposite the original figures for Tens and Units, 11 and 24, under the base-number 13, appears the figure 8.

(3) The required figures are 111 and 124.

(4) Delete such figures as 111, 222, 333 . . 999 and proceed with List of Errors under the first hundred by adding the base-number 13 to each three figures, *e.g.* 124, 137, 150, 163, 176, 189.

(5) Repeat the process for each original figure for Hundreds.

SCHEDULE G.

ERRORS

which will not be detected by adopting the respective base-numbers 14, 13, 17, and 19, *e.g.*

Posting £123 as £231.

No. of Errors.	Base-Numbers.			
	14	13	17	19
	£	£	£	£
1	125	124	128	130
2	139	137	145	149
3	153	150	162	168
4	167	163	179	187
5	181	176	196	241
6	195	189	239	260
7	236	235	256	279
8	250	248	273	298
9	264	261	290	314
10	278	274	316	352
11	292	287	350	371
12	319	320	367	390
13	347	346	384	425
14	361	359	410	463
15	375	372	427	482
16	389	385	461	517
17	416	398	478	536
18	430	418	495	574
19	458	431	521	593
20	472	457	538	628
21	486	470	572	647
22	513	483	589	685
23	527	496	615	720
24	541	516	632	739

No. of Errors.	Base-Numbers. 14	13	17	19
	£	£	£	£
25	569	529	649	758
26	583	542	683	796
27	597	568	726	812
28	610	581	743	831
29	624	594	760	850
30	638	614	794	869
31	652	627	820	923
32	680	640	837	942
33	694	653	854	961
34	721	679	871	980
35	735	692	914	
36	749	712	931	
37	763	725	948	
38	791	738	965	
39	818	751	982	
40	832	764		
41	846	790		
42	860	810		
43	874	823		
44	915	836		
45	929	849		
46	943	862		
47	957	875		
48	971	921		
49	985	934		
50	—	947		
51	—	960		
52	—	973		
53	—	986		

NOTE.

There are over 100 errors which will not be detected by adopting base-number 7.

SCHEDULE I.

Schedule used for discovering Transpositions of Three Figures in Pounds Column which will not be detected by the respective base-numbers, *e.g.*

Posting £123 as £312.

(1) HUNDREDS AND TENS.

Original Figures for Hundreds & Tens	Difference created by transposition.	Variation in Check-figure (all negative checks). Base-numbers				
		7	14	13	17	19
10 ...	90 ...	6	6	12	5	14
11 ...	99 ...	1	1	8	14	4
12 ...	108 ...	3	10	4	6	13
13 ...	117 ...	5	5	0	15	3
14 ...	126 ..	0	0	9	7	12
15 ...	135 ...	2	9	5	16	2
16 ..	144 ...	4	4	1	8	11
17 ...	153 ...	6	13	10	0	1
18 ...	162 ...	1	8	6	9	10
19 ..	171 ...	3	3	2	1	0
20 ...	180 ...	5	12	11	10	9
21 ...	189 ...	0	7	7	2	18
22 ...	198 ...	2	2	3	11	8
23 ...	207 ...	4	11	12	3	17
24 ...	216 ..	6	6	8	12	7
25 ...	225 ...	1	1	4	4	16
26 ...	234 ...	3	10	0	13	6
27 ...	243 ...	5	5	9	5	15
28 ...	252 ...	0	0	5	14	5

(2) UNITS.

Original Figure for Units.	Difference created by transposition.	Variation in Check-figure (all positive checks). Base-numbers				
		7	14	13	17	19
1	99	1	1	8	14	4
2	198	2	2	3	11	8
3	297	3	3	11	8	12
4	396	4	4	6	5	16
5	495	5	5	1	2	1
6	594	6	6	9	16	5
7	693	0	7	4	13	9
8	792	1	8	12	10	13
9	891	2	9	7	7	17

Method explained :—

(1) Commence with the Hundreds and Tens: Opposite the original figures for Hundreds and Tens, 10 and 23, under the base-number 13, appears the figure 12.

(2) Look for the same variation in the Units section. Opposite the original figure for Units, 8, under the base-number 13, appears the figure 12.

(3) The required figures are 108, and 238.

(4) Delete such figures as 111, 222, 888, 999, and proceed with List of Errors by adding the base-number 13 to the first two figures *e.g.*, 108, 238, 368, 498, 628, 758.

(5) Repeat the process for each of the original figures for Hundreds and Tens.

(6) Re-arrange in numerical order.

SCHEDULE I.

ERRORS

which will not be detected by adopting the respective base-numbers, 14, 13, 17, and 19, *e.g.* Posting £123 as £312.

No. of Errors.	Base-Numbers.			
	14	13	17	19
	£	£	£	£
1	106	108	104	128
2	135	127	149	143
3	159	146	156	175
4	164	165	163	207
5	188	184	208	239
6	193	203	215	254
7	217	219	267	286
8	246	238	274	301
9	251	241	281	318
10	275	257	319	365
11	299	276	326	397
12	304	295	378	412
13	328	314	385	429
14	357	349	392	476
15	362	352	437	491
16	386	368	451	508
17	391	371	489	523
18	415	387	496	587
19	439	406	503	602
20	468	425	548	619
21	473	463	562	634
22	497	479	607	681
23	502	482	614	698
24	526	498	621	713

No. of Errors.	Base-Numbers. 14	13	17	19
	£	£	£	£
25	531	501	659	745
26	579	517	673	792
27	584	536	718	809
28	608	574	725	824
29	613	593	732	856
30	637	609	784	871
31	642	612	791	903
32	671	628	829	935
33	695	631	836	967
34	719	647	843	982
35	724	685	895	
36	748	704	902	
37	753	723	947	
38	782	739	954	
39	806	742	961	
40	811	758		
41	835	761		
42	859	796		
43	864	815		
44	893	834		
45	917	853		
46	922	869		
47	946	872		
48	951	891		
49	975	907		
50	...	926		
51	...	945		
52	...	964		
53	...	983		

Note.

There are over 100 errors which will not be detected by adopting base-number 7.

SCHEDULE L.

Schedule used for discovering errors similar to the following :—

Posting £21 4s. 6d. as £ 2 14s. 6d., or
£ 2 14s. 6d. as £21 4s. 6d.

CONSTANT DIFFERENCE, 10/-			
Base Number.	Variation in Check-figure.		
	Check-figure for 1/- (positive).	Check-figure for 10/-	
		Positive Checks.	Negative Checks.
7	6	4	3
14	12	8	6
13	11	6	7
17	1	10	7
19	1	10	9

Method explained :—

The checks shown in the last column on this side are negative checks.

The checks shown on the other side are positive checks.

Where the figure 3 appears under base-number 7 the lower figure in the pounds column shown opposite will appear in the following List of Errors. Continue the list in arithmetical progression, using the base-number as the constant difference.

Lower figure in £ Col.	Difference created by misposting.	Variation in Check-figure (all positive checks). BASE-NUMBERS. 7	14	13	17	19
£	£					
1	9	2	4	4	10	9
2	18	4	8	8	3	18
3	27	6	12	12	13	8
4	36	1	2	3	6	17
5	45	3	6	7	16	7
6	54	5	10	11	9	16
7	63	0	0	2	2	6
8	72	2	4	6	12	15
9	81	4	8	10	5	5
10	90	6	12	1	15	14
11	99	1	2	5	8	4
12	108	3	6	9	1	13
13	117	5	10	0	11	3
14	126	0	0	4	4	12
15	135	2	4	8	14	2
16	144	4	8	12	7	11
17	153	6	12	3	0	1
18	162	1	2	7	10	10
19	171	3	6	11	3	0

SCHEDULE L.

Differences varying from £9 10s. 0d. to £990 10s. 0d. which will not be detected by the respective base-numbers if the amounts are posted as follow :—

Posting £21 4s. 6d. as £ 2 14s. 6d. or
£ 2 14s. 6d. as £21 4s. 6d.

Base-numbers 7 and 14 :—

£5	£19	£33	£47	£61	£75	£89	£103
12	26	40	54	68	82	96	110

Base-number 13 :—

£5 £18 £31 £44 £57 £70 £83 £96 £109

Base-number 17 :—

£16 £33 £50 £67 £84 £101

Base-number 19 :—

£1 £20 £39 £58 £77 £96.

NOTE.—Each amount shown above is what would appear in the Account Book showing the *lower* amount, *e.g.* the £1 shown under base-number 19 suggests £1 14s. 6d. and £1 13s. 4d. posted to the Ledger as £11 4s. 6d. and £11 3s. 4d. respectively, and *vice versa*. The difference in the Trial Balance will be nine times the number of pounds shown under each base-number + 10/-, *e.g.* as in the above mis-postings :—

	£	s.	d.
£1 × 9 =	9	0	0
Add		10	0
Error in Trial Balance	£9	10	0

Schedule M.

Errors in this Schedule will be detected by every base-number. (See pages 36 and 37).

Other Errors.

These may be classified as follow:—

(1) Schedule N.

e.g., Posting 1/2 as 12/- and *vice versa*.

The errors in this Schedule are made up of a constant difference of 9/- and a multiple of 11d., and are as follow:—

				Difference.	Will not be detected by Base-Nos.
1/1	posted as	11/-	and *vice versa*	9/11	7 and 17
1/2	„	12/-	„	10/10	13
1/3	„	13/-	„	11/9	
1/4	„	14/-	„	12/8	19
1/5	„	15/-	„	13/7	
1/6	„	16/-	„	14/6	
1/7	„	17/-	„	15/5	
1/8	„	18/-	„	16/4	7 and 14
1/9	„	19/-	„	17/3	

(2) Schedule O.

e.g., Posting £1 2s. 3d. as £12 3s. 0d.

Observe:—

(1) That the shillings and pence are posted as pounds and shillings respectively.

(2) That the pounds are posted as tens of pounds.

(3) The difference is therefore made up of a multiple of £9 and a combination of multiples of 19/- and 11d.

(3) SCHEDULE P.

e.g., Posting 2/3 as £23.

Observe :—

(1) That the pence are posted as pounds, and this portion of the difference is made up of a multiple of 19/- and a multiple of 11d.

(2) That the shillings are posted as tens of pounds and this difference is made up of a multiple of 199/-, *i.e.*, a multiple of 19/- and a multiple of 9/-

It is obvious that the shillings must exceed the pounds in the original amount, and that the pounds must exceed the shillings when an error is made. The use of double columns, as suggested with base-number 19, should detect all errors of this description.

In case an error should occur under Schedule O or Schedule P without being detected by the use of double columns the amounts which will give the same check-figure as the larger amounts are noted hereunder :—

SCHEDULE O.

Posting the following combinations of Pounds

and Pence with *any* number of shillings up to 9, viz.:

1 Pound and 4 Pence.
2 „ „ 8 „
5 „ „ 1 „
6 „ „ 5 „
7 „ „ 9 „

Posting the following combinations of Pounds and Pence with *any* number of shillings from 10 to 19.

1 Pound and 6 Pence.
4 „ „ 5 „
7 „ „ 4 „

SCHEDULE P.

			£	s.	d.		Difference. £	s.	d.
Posting	1/4	as	14	0	0	...	13	18	8
„	2/8	„	28	0	0	...	27	17	4
„	5/1	„	51	0	0	...	50	14	11
„	6/5	„	65	0	0	...	64	13	7
„	7/9	„	79	0	0	...	78	12	3
„	10/2	„	102	0	0	...	101	9	10
„	11/6	„	116	0	0	...	115	8	6
„	15/3	„	153	0	0	...	152	4	9
„	16/7	„	167	0	0	...	166	3	5
„	19/-	„	190	0	0	...	189	1	0

To ascertain the errors which will not be detected by adopting any of the other base-numbers, proceed in the same manner as indicated on page 88. Note that the variations in the

check-figures of the pounds under Schedule O when the number of shillings exceeds 9 must be reckoned on the basis of units posted as hundreds of pounds.

The errors caused by the transposition of any figures in the pounds, shillings and pence columns have now been exhaustively dealt with. The last two Schedules have been introduced specially at this stage with the view of facilitating the discovery of errors caused by transposing *any* figures in the pounds, shillings and pence columns within reasonable limits, *i.e.*, not exceeding three figures in the pounds column.

All errors caused either by the introduction of other figures, or by the alteration of existing figures, will be detected by any base-number, unless the differences created by the erroneous postings are multiples of the base-number.

If an entry in the Primary Record immediately above or under the amount should inadvertently be posted instead of the correct amount, the substituted amount must differ exactly by a multiple of the base-number if such an error is not detected by a Check Figure System. A simple remedy, to insure that no mispostings of this nature have occurred during the financial period, is to look for recurring check-figures, and, if the entries opposite are not identical, to check such postings to the Ledger.

It is obvious that, to discover errors in this category, a large base-number such as 19 will be much more effective than a smaller base-number, and, further, that no alteration of existing figures can be made in the shillings or pence columns (unless *both* columns are entered erroneously so as to differ by 1/7 or any multiple of 1/7 up to 19/-) without being detected.

The total number of errors in Schedules A to N which will not be detected by adopting the respective base-numbers 7, 14, 13, 17, and 19 is shown on the next page.

It should be clearly understood that the number of errors indicated in this part, with the exception of Schedules B and D, refers strictly to the particular columns under review, and that such errors will occur with *any* figure usually placed in the other columns, or portion of columns.

SUMMARY OF ERRORS

which will not be detected by adopting the respective base-numbers.

Schedule.	Base-Numbers.				
	7	14	13	17	19
A	10	—	—	—	—
B	*550	300	347	268	—
C	34	10	12	4	— (a)
D	*300	172	203	156	—
E	10	—	—	—	—
F	6	—	—	—	—
G	*100	49	53	39	34 (b)
H	6	6	—	—	—
I	*100	49	53	39	34 (b)
K	6	—	—	—	—
L	32	32	18	12	12
M	—	—	—	—	—
N	4	2	2	2	2
Total ...	1158	620	688	520	82

* Approximate figures.

(a) Using original formula, with double columns.

(b) Displacing three consecutive figures in pounds column—very improbable errors. Lowest error £171.

PART V.

HINTS TO BOOKKEEPERS,

showing how the errors dealt with in Part IV may be speedily discovered.—Subdivision of Errors.—Errors not exceeding £1.—Errors over £1 and under £20.—Errors over £20 and under £90.—Errors of £90 and upwards.—Quick methods for locating large differences.

If £1	is posted as	1d.	the difference is	− 239	pence
„ „	„	1/-	„	− 228	„
„ 1/-	„	£1	„	+ 228	„
„ „	„	1d.	„	− 11	„
„ 1d.	„	£1	„	+ 239	„
„ „	„	1/-	„	+ 11	„

Let a represent the number of pounds.
„ b „ „ shillings.
„ c „ „ pence.

	£	s.	d.	
Transpose	a	b	c	as follows:—

				Difference in Pence.
A	a	c	b	$11c - 11b$
B	b	c	a	$228b + 11c - 239a$
C	b	a	c	$228b - 228a$
D	c	a	b	$239c - 228a - 11b$
E	c	b	a	$239c - 239a$

The differences under each class may be restated as follow:—

Schedule	A	$11\ (c - b)$
„	B	$228\ (b - a) + 11\ (c - a)$
„	C	$228\ (b - a)$
„	D	$228\ (c - a) + 11\ (c - b)$
„	E	$228\ (c - a) + 11\ (c - a)$

228 pence = 19/-

		Lowest Difference.		Highest Difference. £ s. d.
Schedule	A	11d.	...	0 10 1
„	B	8/11	...	18 11 1
„	C	19/-	...	18 1 0
„	D	8/11	...	18 11 1
„	E	19/11	...	10 19 1

Errors under £1 in Schedules B and D will be made up as follow:—

19/-	−	10/1	=	8/11
„	−	9/2	=	9/10
„	−	8/3	=	10/9
„	−	7/4	=	11/8
„	−	6/5	=	12/7
„	−	5/6	=	13/6
„	−	4/7	=	14/5
„	−	3/8	=	15/4
„	−	2/9	=	16/3
„	−	1/10	=	17/2
„	−	11d.	=	18/1

Errors not exceeding £1.

To discover whether it is possible for an error

in the Trial Balance to be a transposition under any of the Schedules A, B, C, D and E ascertain the following:—

SCHEDULE A.

(a) Is it a multiple of 11d. not exceeding 10/1? (See page 138).

If so, and the error is not 9/2 (see page 36), look at once for a difference between the shillings and pence columns represented by the multiple; *e.g.*, 2/9 suggests a difference of 3 between the shillings and pence.

SCHEDULES B AND D.

(b) If not a multiple of 11d., deduct error from 19/-, *e.g.*,

19/- − error, say 11/8 = 7/4.

If the remainder is a multiple of 11d., the transposition will be classified either under Schedule B or Schedule D, as differences under Schedule E are always made up of the same multiples of 19/- and 11d., and both multiples have always the same sign, *i.e.*, + or −.

If the error is 11/8 how is this to be detected?

Refer to the algebraic formula for differences under Schedule B.

+19/- suggests a difference of 1 between the pounds and shillings and that the *shillings* are greater.

− 7/4 suggests a difference of 8 between the pounds and pence and that the

+11/8 *pounds* are greater.

The amount misposted may therefore be £8 9 0
posted as 9 0 8

Error under Schedule B + 0 11 8

As errors under Schedule D are simply the reverse postings, it is obvious that the sign opposite the 11/8 must be a *minus* sign, *e.g.*,

£9 0 8
posted as 8 9 0

Error under Schedule D − 0 11 8

It will be explained shortly that the error may also be the result of any of the following mispostings, viz.:

£ s. d.		£ s. d.
9 10 1	posted as	10 1 9
10 11 2	„	11 2 10
11 12 3	„	12 3 11

−19/-	suggests a difference of 1 between the pounds and shillings and that the *pounds* are greater.
+ 7/4	suggests a difference of 8 between the pounds and pence and that the
−11/8	*pence* are greater.

The amount misposted may therefore be £1 0 9
posted as 0 9 1

Error under Schedule B −0 11 8

but it may be any of the following mispostings, viz.:—

£ s. d.		£ s. d.
2 1 10	posted as	1 10 2
3 2 11	„	2 11 3

The latter amounts, in each case, represent the errors under Schedule D, which are the reverse postings of those indicated above, and consequently the sign opposite the 11/8 will be the reverse of that under Schedule B.

SCHEDULE C.

(c) If the error is 19/- the error may arise from a difference of 1 between the pounds and shillings columns.

(d) If the error is 19/11, the error may arise from a difference of 1 between the pounds and pence columns.

OTHER ERRORS.

(e) If not a transposition under any of these Schedules, deduct 9/- from the error, and if the difference is a multiple of 11d., *e.g.*, 11/9 − 9/- = 2/9, the error is most likely to be accounted for by 1/- + the number of pence represented by this multiple being posted as shillings in this manner: 1/3 posted as 13/- (See pages 121 and 139).

(f) It is assumed that errors commonly made in additions are first considered before these tests are applied, not necessarily in the above order.

Errors over £1 and under £20.

Errors under Schedule C are easily located, *e.g.*, £6 13s. (19/- × 7) means a difference of 7 between the pounds and shillings columns; the most probable error being 7/- posted as £7.

Errors under Schedule E are also easy to locate, as the difference between the pounds and pence requires only to be considered, and the multiple

of 11d. must always be the *same* as the multiple of 19/-, *e.g.*,

An error in the Trial Balance of

	£	s.	d.	
	3	19	8	
suggests at once	3	16	0	= 19/- × 4
and a difference of	0	3	8	= 11d. × 4

As the multiples of 19/- and 11d. are identical, the error can only be classified under Schedule E, the most probable errors being

4/4 posted as £4 4s. 0d. and *vice versa*.

The same error will also be caused by the transposition of *any* numbers in the pounds and pence columns whose difference is 4. The simplest plan, therefore, is to ignore the shillings column entirely and check all items which show a difference of 4 between the figures in the pounds and pence columns. If a *credit* of £3 19s. 8d. is required, it is useless checking items in a Sales Journal where the pounds *exceed* the pence by 4. The examination of the Sales Journal should be restricted to items where the number of pounds is 4 *less* than the number of pence, *e.g.*,

£	s.	d.		£	s.	d.
5	16	9	posted as	9	16	5
7	13	11	„	11	13	7
4	17	8	„	8	17	4

The highest figure in the pence column being 11, all items in the Sales Journal over £7 may be ignored during the first scrutiny. It may afterwards be necessary to examine the *units* in the pounds column, in which case the highest figure looked for would be 5, *e.g.*

£45 16s. 9d. posted as £49 16s. 5d.
£73 os. 7d. „ £77 os. 3d.

Schedules B and D.

An error in the Trial Balance of

	£ s. d.	
	7 13 10	
would suggest ...	7 12 0	= 19/- × 8
and the difference	0 1 10	= 11d. × 2

would indicate that the most probable errors are

8/2 posted as £8 2s. od. and *vice versa.*

When the multiples of 19/- and 11d. vary, the errors must be classified under Schedules B and D., *e.g.*,

Schedule B. Schedule D.
8/2 posted as £8 2s. od. and *vice versa.*

Other transpositions under these Schedules creating the same difference in the Trial Balance may be obtained by adding £1 1s. 1d. in arithmetical progression until the number of pounds or pence under Schedule B becomes 11, or the shillings 19, *e.g.*,

Schedule B. £	s.	d.		Schedule D. £	s.	d.		
1	9	3	posted as	9	3	1	and	*vice versa*
2	10	4	„	10	4	2		„
3	11	5	„	11	5	3		„
4	12	6	„	12	6	4		„
5	13	7	„	13	7	5		„
6	14	8	„	14	8	6		„
7	15	9	„	15	9	7		„
8	16	10	„	16	10	8		„
9	17	11	„	17	11	9		„

Observe :—

That the differences between the pounds and shillings, and between the pounds and pence, under Schedule B, are respectively + 8 and + 2.

That the differences between the pounds and pence, and between the shillings and pence, under Schedule D, are respectively − 8 and − 2.

That the algebraic formulæ for differences under Schedules B and D denote that the multiples of 19/- and 11d. may be either positive or negative.

If the signs are reversed, therefore, the following transpositions may also be put down at once, viz. :—

Schedule B.				Schedule D.			
£	s.	d.		£	s.	d.	
11	3	9	posted as	3	9	11	and *vice versa*
10	2	8	„	2	8	10	„
9	1	7	„	1	7	9	„
8	0	6	„	0	6	8	„

It is obvious that, if the error of £7 13s. 10d. is not discovered after looking for 8/2 posted as £8 2s., or *vice versa*, some system is necessary in order to locate differences which may arise from so many possible mispostings.

Observe :—

That the difference between the shillings and pence under Schedule B is 6.

That the difference between the pounds and shillings under Schedule D is also 6.

If a *credit* of £7 13s. 10d. is required to balance any of the Sales Ledgers, it is useless examining amounts in the Sales Journal above £10 for possible transpositions. Note also that, under Schedule D, amounts above £4 may be ignored. Transpositions under Schedule B will be restricted to amounts under £10, and the difference of 6 must be looked for on the right, whereas transpositions under Schedule D must show a difference of 6 on the left, *i.e.*, between the pounds and shillings columns. Every item showing a difference of 6 need not be compared

with the Ledger. If the difference is found on the right, *i.e.* between the shillings and pence columns, there must also be a difference of 8 between the pounds and shillings columns.

It is hardly necessary to point out that all errors of transposition under Schedules B and D cannot be treated exactly in accordance with the limitations suggested for an error of £7 13s. 10d. When all the possible transpositions are written down, ascertain the difference common to both Schedules, and note the highest and lowest amounts in the pounds column which require to be examined.

A credit required in the Sales Ledger also suggests an increase to some posting on the credit side, and if an error of £7 13s. 10d. was made when posting from the Cash Book or Credit Journals, the examination of these records would be restricted to transpositions of amounts between £8 and £12, under Schedule B, showing a difference of 6 between the shillings and pence columns, and to transpositions of amounts over £9 and not exceeding £18, under Schedule D, showing a difference of 6 between the pounds and shillings columns.

The highest difference which can appear in the Trial Balance as the result of any transposition which may be classified under Schedules A, B, C, D, and E is £18 11s. 1d.

Differences under Schedule A are easily distinguished, as the shillings and pence added together must equal 11.

Differences under Schedules B and D are also easily distinguished, as the total of the figures appearing in the pounds, shillings and pence columns must equal 11, 19, or 30. When the total is 19, the error is made up of a multiple of 19/- *minus* a multiple of 11d. When the total is 11 or 30, the error is made up of a multiple of 19/- *plus* a multiple of 11d.

Differences under Schedule E always have 19 in the shillings column, and the total of the pounds and pence columns is always 11.

The following table will be useful in localising errors under the remaining Schedules referred to in Part IV., viz.:—

		Lowest difference.			Highest difference.		
		£	s.	d.	£	s.	d.
Schedule	F	9	0	0	81	0	0
	G	108	0	0	882	0	0
	H	90	0	0	810	0	0
	I	108	0	0	882	0	0
	K	99	0	0	891	0	0
	L	9	10	0	999	10	0
	M	0	9	2	0	9	2
	N	0	9	11	0	17	3
	O	9	19	11	909	11	1
	P	10	18	11	198	0	3

The errors in Schedules M and N do not exceed £1 and have already been referred to. Note that all the shillings and pence enumerated under Schedule N on page 121 equal 20.

The only errors over £1 and under £20 remaining to be dealt with will appear under Schedules F, L, O, and P.

The only errors under Schedule F will be £9 and £18. These errors indicate differences of 1 and 2 respectively between the tens and units in the pounds column, *e.g.*

£78 posted as £87 and *vice versa.*
£68 „ £86 „

The only differences under Schedule L will be £9 10s. and £18 10s. To discover an error of £9 10s. it is only necessary to look for 11 or 1 in the pounds column in the first instance. Items over £11 9s. 11d. and under £1 10s. 0d. need not be checked. Similarly, to discover an error of £18 10s., examine the pounds column in the Primary Records to detect the figures 21 and 2, and check all items from £21 to £21 9s. 11d. or items over £2 9s. 11d. and under £3.

Note that an error of £9 10s. may also be a transposition under Schedule C, and that only one of the above figures need be searched for in each Primary Record, if careful consideration is given to the fact that it is useless looking for

£2 in a Sales Journal when a *debit* of £18 10s. is required to make the Trial Balance agree.

Differences under Schedule O may be speedily recognized by adding the figures representing differences under £20, and if the total, reduced by 11, 19, or 30, equals a multiple of 9 proceed in this manner:—

(1) Throw out the nearest multiple of £9. If the figure in the pounds column is a multiple of £9, throw out the next lower multiple.

(2) Ascertain the shillings and pence which have been posted as pounds and shillings, *e.g.*

	£	s.	d.	
Difference	18	1	1	=20−11=9
Deduct multiple of £9	9	0	0	=£9×1
The remainder ...	£9	1	1	

is made up of £8 11s. and 10/1, consequently £1 9s. 11d. may have been posted as £19 11s. 0d.

The amount misposted is the number of pounds indicated by the multiple of £9 *plus* the multiples of 19/- and 11d. obtained from the remainder.

Differences under Schedule P not exceeding £20 may be recognized at once, as the number in the shillings column is always 18, and the total of the pounds and pence columns is always 21.

Errors over £20 and under £90

Refer to the table on page 138. Schedules F, L., O, and P, need only be considered.

The errors under Schedule F will be as follow :—

£27, £36, £45, £54, £63, £72, £81.

Divide the pounds by 9 and look for a difference between the tens and units as indicated by the quotient.

The errors under Schedule L will be as follow :—

£27 10s., £36 10s., £45 10s., £54 10s.,
£63 10s., £72 10s., £81 10s.

Divide the pounds by 9 and proceed in the same manner as already suggested for a difference of £18 10s. 0d.

Errors under Schedule O have been already treated. The highest figures in the shillings and pence columns which can be posted as pounds and shillings to produce an error under £90 are 9/9. *e.g.*

	£	s.	d.
	9	9	9
posted as	99	9	0
difference	£89	19	3

consequently the highest difference required, after

dividing the pounds by 9, is £8 19s. 3d. The highest possible difference for transpositions of shillings and pence as pounds and shillings is £18 11s. 1d., and this suggests that it may be necessary with *larger* differences to carry over £18 from the quotient after dividing the pounds column by 9. For errors under £90, however, proceed as previously directed.

To locate errors under Schedule P, deduct the shillings and pence from £1, and if the remaining shillings and pence read together as pounds, exceed the pounds by 1, the error may be accounted for by posting the latter shillings and pence in the pounds column.

Errors of £90 and upwards.

If the error is £90 or a multiple of £90 refer to Schedule H on page 33.

If the error is £99 or a multiple of £99 refer to Schedule K on page 34.

Differences under Schedules G and I may be located more quickly by noting the difference between the figures representing the multiple of £9 (see page 33). Study the methods explained on pages 111 and 115.

To locate an error of £369.

$$\frac{369}{9} = 41.$$

Write down 000, 111, 222, 333, . . . to 999

and add or deduct the multiple of 9 represented by the difference in the Trial Balance to each of these figures, *e.g.*

	000	111	222	333
Add	41	41	41	41
	041	152	263	374
	444	555	666	
Deduct	41	41	41	
	403	514	625	
	444	555		
Add	41	41		
	485	596		
	777	888	999	
Deduct	41	41	41	
	736	847	958	

Prepare a List of Errors under Schedules G and I from the above figures, *e.g.*

No. of Errors.	*Schedule G.*		*Schedule I.*	
	£		£	
1	041	posted as	410	and *vice versa.*
2	152	,,	521	,,
3	263	,,	632	,,
4	374	,,	743	,,
5	403	,,	034	,,
6	485	,,	854	,,
7	514	,,	145	,,
8	596	,,	965	,,
9	625	,,	256	,,
10	736	,,	367	,,
11	847	,,	478	,,
12	958	,,	589	,,

Observe:—

That errors under Schedule G, Nos. 1, 2, 3, 4, 6, and 8, which were obtained by *adding* 41 to the figures which cannot be transposed would account for a *greater* amount in the Ledger to the extent of £369.

That errors under Schedule G, Nos. 5, 7, 9, 10, 11, and 12, which were obtained by *deducting* 41 from the figures which cannot be transposed would account for a *less* amount in the Ledger to the extent of £369.

That errors under Schedule I are simply the reverse postings of those under Schedule G.

No other transposition will produce the same difference of £369. On page 33 it is stated that the multiple of 99 is derived from the figure shown as hundreds. The above process cancels the variation under each hundred, *e.g.*

Variation after transposition.

263	=	200	−99	× 2	=	−198
	+	22	22	× 9	=	+198
	+	41	41	× 9	=	+369
Increase after transposition as 632						369

Re-arrange the above errors, so that increases and decreases may be shown separately.

No. of Errors.	*Schedule G.*		*Schedule I.*	
	£		£	
1	041	posted as	410	and *vice versa.*
2	152	,,	521	,,
3	263	,,	632	,,
4	374	,,	743	,,
6	485	,,	854	,,
8	596	,,	965	,,
5	403	posted as	034	and *vice versa.*
7	514	,,	145	,,
9	625	,,	256	,,
10	736	,,	367	,,
11	847	,,	478	,,
12	958	,,	589	,,

In the first group, the errors under Schedule G indicate an *increased* posting of £369 in the Ledger, whereas those under Schedule I indicate a *decreased* posting.

In the second group, the errors under Schedule G indicate a *decreased* posting of £369 in the Ledger, whereas those under Schedule I indicate an *increased* posting.

If a debit of £369 is required in the Sales Ledger, the error will most likely be found in the first group under Schedule I, or in the second group under Schedule G. Note that the common difference is 3, and that the examination of the Sales Journal may be restricted to amounts showing a difference of 3 between the hundreds and tens (the hundreds being greater), and to amounts showing the same difference between the tens and units (the units being greater).

If the *tens* do not exceed the units by 1 when the hundreds are greater than the tens, and if the *hundreds* do not exceed the units by 1, when the units are greater than the tens, the amounts need not be compared with the Ledger.

Other errors in these Schedules may be located by adopting similar methods.

Errors under Schedules L, O, and P, may also appear as the result of differences over £90, but these have already been fully dealt with.

Errors of £900 and upwards.

Very large errors are easily located, as they are generally transpositions of this nature, *e.g.*

£2356 8s. posted as £23568.

Difference £21211 12s.

Divide the pounds by 9.

$$\frac{21211}{9} = 2356\frac{7}{9}$$

Add the remainder to the shillings, *i.e.*

£7 12s.

= 19/- × 8

The error may therefore be accounted for by posting £2356 8s. as £23568, the difference between 8/- and £8 being 8 times 19/-, and the difference between £2356 and £23560 being 9 times the lower amount, viz., £21204, as explained frequently in these pages.

If the error is not discovered by this method, refer to the table on page 138, and carefully consider the possibility of similiar errors occurring as the result of transpositions of the figures preceding the tens or units in the pounds column.

PART VI.

SPECIAL CHECK FIGURE SYSTEMS

For Countries in which Decimal Coinage is in use.

In most countries in which Decimal Coinage is in use, the figures which invariably appear on the extreme right of any amount are 0 and 5.

Base-number 19.

With base-number 19, the mental calculation is thus considerably reduced when ascertaining the check-figures of amounts represented by not more than five figures, *i.e.*, three figures in the francs or marks column and two figures in the centimes or pfennige column.

In Part III the figures in the pounds column are treated as so many *units* (the check-figure for £1 being 1), and as it may not readily occur to the reader that the last figure in the centimes column need not necessarily be considered as so many units, it is advisable to explain more fully, in this Part, how the calculations may be curtailed by making the check-figure for each unit in the *francs* column 1, and utilising the knowledge acquired from the study of the principles inculcated on page 85.

If the check-figure for 1 Franc or 100 Cents. is 1
the check-figure for 10 „ is 2
„ „ 1 „ is 4

Francs. Cents.
Required the check-figure of 265 · 85

Mental process:—

Divide centimes by 5 ; 85÷5= 17
Add the francs 265

282=16

(see page 25)

Francs. Cents.
The check-figure of 265 · 85 is 16.

In case a figure other than 0 or 5 should occasionally appear as the last figure in the centimes column, the following check-figures should be thoroughly learned, viz.:—

Check-figure for 1 centime is 4
„ 2 „ 8
„ 3 „ 12 or − 7
„ 4 „ 16 or − 3

Francs. Cents.
Required the check-figure of 126 · 42

42÷5 is 8 and leaves 2 (*i.e.* 8).
∴ the check-figure of 42 centimes = 8+8
= 16
Add the francs 126

142 = 9

Francs. Cents.
The check-figure of 126 · 42 is 9.

Francs. Cents.
Required the check-figure of 167 · 39

39÷5 is 7 and leaves 4 (*i.e.* − 3).

∴ the check-figure of 39 centimes = 7 − 3

= 4

Add the francs 167

171 = 0

Refer to page 25 for the calculation of odd amounts, and compare process with base-number 7 on page 67 for £257.

The check-figure of 171 = 8 + 11 = 19 *i.e.* 0.

Francs. Cents.
The check-figure of 167 · 39 is 0.

It has already been proved that transpositions of any two out of three consecutive figures will be detected by base-number 19, and that there are only 68 numbers between 1 and 1,000 respecting which the same base-number will prove ineffective in detecting displacements of *all three figures* (see pages 108 to 117). As such mispostings may occur with larger numbers—999 only representing 9 francs 99 centimes—the following errors should be added to those enumerated under Schedules G. and I. viz.:—

	Schedule G.		Schedule I.	
1.	203	posted as	032	and *vice-versa*.
2.	406	,,	064	,,
3.	609	,,	096	,,
4.	701	,,	017	,,
5.	904	,,	049	,,

These are obtained by subtracting 19 from the first number shown under each hundred in Schedule G.

Base-number 13.

If the bookkeeper is convinced that the errors shown in Schedules G and I are very improbable, there is no reason why he should not adopt base-number 13 in preference to base-number 19, more especially in America, where 5 cents are of more value than 5 centimes, and consequently *every* number from 0 to 9 may appear as the last figure.

For amounts represented by more than 5 figures base-number 13 might very usefully be employed, *e.g.*

Required the check-figure of 2364 · 78 (Dollars. Cents.)

Mental process:—

478 − 236 = 242 (see pages 74 and 75).

Divide 24 by 4 and add 2 = 8

The check-figure of 2364 · 78 (Dollars. Cents.) is 8

Required the check-figure of 53,642 · 59 (Dollars. Cents.)

364 − 5 = 359
259 − 359 = − 100 } (See page 75 Ex. 1)

next higher multiple is 104

∴ the check-figure is 104 − 100 = 4.

On the other hand, if the bookkeeper thinks that, however careful he may be, there *is* a slight chance of such errors enumerated in Schedules G and I occurring, and that he may be considerably troubled by his Trial Balance being wrong to the extent of a small multiple of 1 dollar 71 cents, he should carefully consider the advisability of using double columns.

Base-number 7 (with double columns).

The use of double columns with base-number 7 would enable the additions of the Dollars and Cents columns to be tested separately, and save a second addition of either the dollars or cents column in many instances.

Double columns cannot be recommended, however, unless the small base-number 7 is used. Where the last figure is generally 0 or 5, errors of transposition in the cents column would be detected, as the difference between the two figures must be 7. The lowest probable error therefore would be 63 dollars, and as the calculations are done very quickly by using the processes given in Part III there is no strain on the bookkeeper when performing the mental calculation. The Primary Records should be examined periodically for differences of 7 as fully dealt with in Part IV.

Example :—

Dollars.	Cents.	Check-figures.	
		$	C.
44	67	2	4
257	35	5	0
1368	72	3	2
738	13	3	6
239	24	1	3
2648	11 2	0	1

Multiples of 7 are so numerous that they can easily be eliminated from the majority of the calculations.

Note that the 2 carried forward from the cents column must be deducted from the total shown in the dollars column, and that 211 cents must be considered as the total of the second column, when reconciling the check-figures for the total.

The check-figure of each hundred in the cents column is 2. As the dollars are treated as so many *units* instead of hundreds, *add* 2 to the first column and *deduct* 4 from the second column before carrying forward the check-figures for each total.

The check-figures may be read as 24, 50, 32, 36, 13 and 1. The highest number is 66, consequently transpositions will be easily detected.

Recommendation for Credits.

The ordinary process as explained in this Part having been used for debits, the easiest plan to distinguish credits from debits is to multiply the check-figures of credits by 10 and rule all Debit Journals with two columns for the check-figures and all Credit Journals with three columns. The Ledgers should have two columns on the debit side and three columns on the credit side. By this method, debits posted as credits and *vice-versa* may be detected at once.

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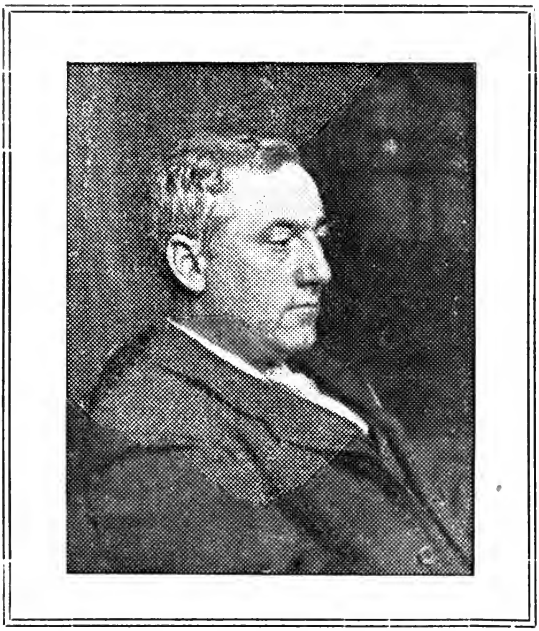

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